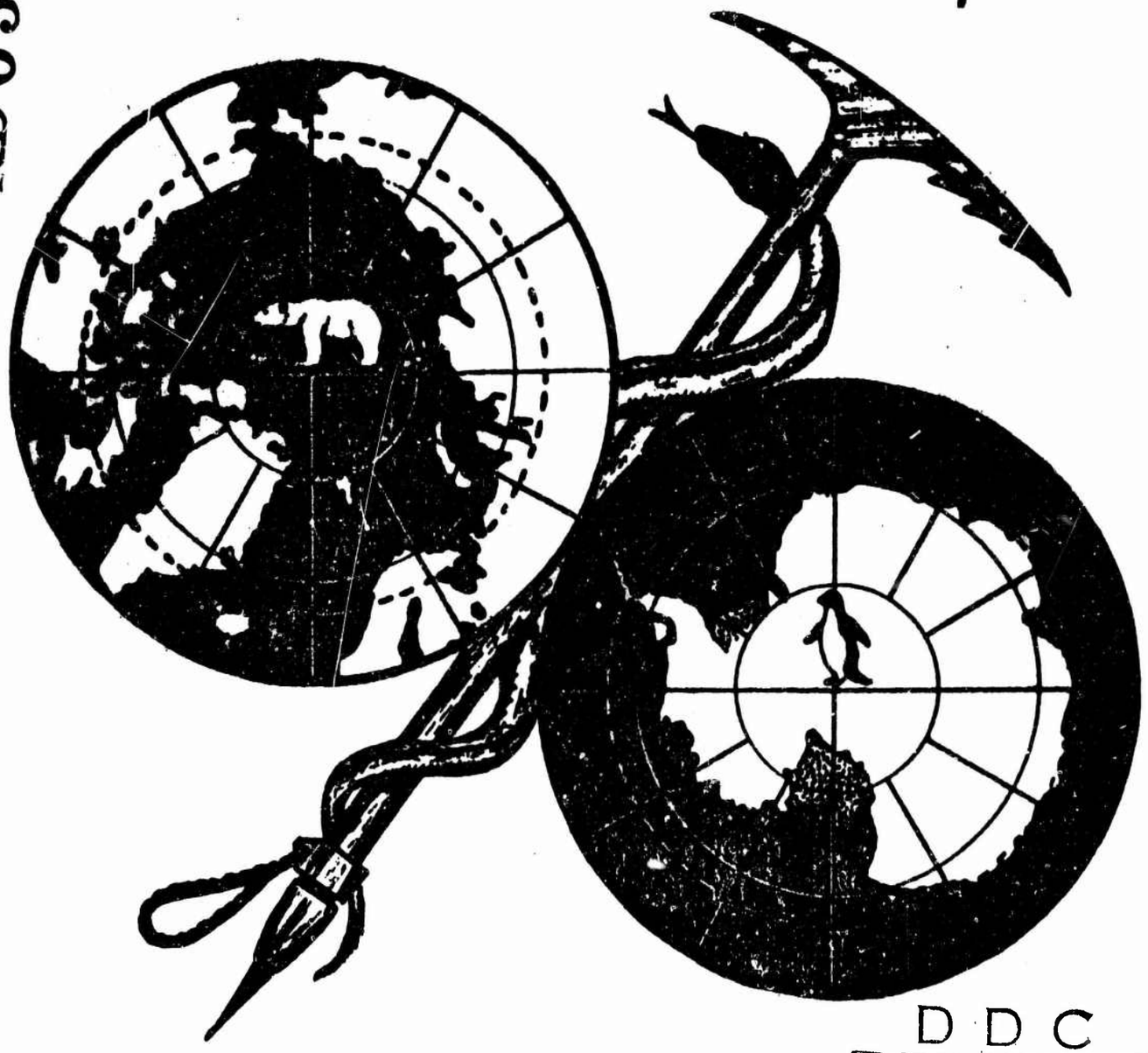
POLAR MANUAL



SAFETY-COLD INJURIES-SURVIVAL
SELECTION-HYGIENE-SANITATION
CLOTHING-NUTRITION-SUPPLIES-EQUIPMENT

FOURTH EDITION
1965

FOREWORD

The original edition of the POLAR MANUAL was prepared by the Department of Cold Weather Medicine of the U.S. Naval Medical School as a guide for personnel whose work would take them to the frigid areas of the earth. It was largely the work of Captain Earland E. Hedblom, MC, USN. Although Captain Hedblom is no longer attached to the Naval Medical School, he very kindly agreed to prepare the present revision. Users of this manual will find his style and personal anecdotes a refreshing departure from most military publications.

This revision includes the latest concepts of preventing freezing injuries as well as additional material on survival techniques. Emphasis throughout has been on the prevention of accidents and illness rather than on therapeusis and cure. It is believed this revised edition will be an effective and useful working handbook for those whose duties take them to the Polar Regions - North or South.

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POLAR MANUAL

ARCTIC AND ANTARCTIC
LIVING CONDITIONS, PERSONNEL SELECTION
HYGIENE AND SANITATION
CLOTHING, NUTRITION, SUPPLIES, AND EQUIPMENT
VISUAL DISABILITIES AND COLD INJURIES
FIRST AID, SAFETY, AND SURVIVAL

by

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PREFACE TO FOURTH EDITION

American physicians have been in the vanguard of polar medicine since U. S. Navy surgeons Elisha Kent Kane (1853) and Isaac I. Hayes (1860) led expeditions to the Arctic, and Frederick A. Cook accompanied the deGerlache Expedition (1897) to Antarctica. In modern times the late Dana Coman of the first Byrd and Ellsworth Expeditions blazed the way, followed by Dr. Russell G. Frazier and LT (now CAPT) Lewis S. Sims, MC, USN, of the U.S. Antarctic Service Expedition, 1939-41. Dr. Donald H. McLean (now CAPT, MC, USN) accompanied the Ronne Antarctic Research Expedition in 1946-48. CAPT Harry B. Eisberg, MC, USN, of Operations NANOOK and HIGH JUMP, 1945-47, later occupied the first Cold Weather Desk in the Navy Bureau of Medicine and Surgery and wrote extensively on Polar Medicine.

At the end of DEEP FREEZE I, a brief set of "Polar Do's and Don't's" was prepared to teach hygiene and safety to personnel going on DEEP FREEZE II. Shortage of funds precluded publishing of this pamphlet; however, in manuscript form, it served as a guide for the first Japanese IGY Expedition of 1956-57.

In the spring of 1959 on the request of the Royal Australian Air Force for recent developments in the care of cold weather casualties, a brief paper was written covering the subject.

During the summer of 1959, the U.S. Antarctic Projects Office received a request from the Belgians for a brief manual to give medical guidance for their Antarctic Expedition. The two original papers were made current, condensed and combined to accomplish this purpose, and the first edition of "Antarctic Manual" was born. From 1956-59 the records and observations of the following Navy physicians contributed to this work: LCDR F.M. Ackroyd; LCDR A.H. Barsoum; LCDR R.C. Bornemann; LT H.Z. Brown; LT A.H. Bridgeman; LT Edward Ehrlich; LT B.C. Dalton; LCDR J.W. Drabkin; LT E.J. Galla; CDR V.N. Houk; LCDR J.W. Potter; LT P.P. Roseski; LT R.S.J. Sparks; LCDR C.H. Taylor III; CDR I.M. Taylor; LCDR S. Tolchin; and LT P.B. Unger.

The author's experiences on DEEP FREEZE 1960; additions and corrections to the first edition solicited from friends with long polar experience; and the work of CDR William J. Mills, MC, USNR, of Anchorage, Alaska, with the first treatment of freezing injuries, made a second edition mandatory in 1960. To this was appended a basic list of medical supplies and equipment suggested to the Arctic Institute of North America for a 16-man, six-month Arctic Expedition which did not include a physician or trained medical attendant, but which had definitive medical care available on a few hour's notice. Each man had advanced first aid training, and some elementary guide to treatment by a layman where a reminder of dosage or admonition seem indicated. No such list is foolproof. It is intended only as a guide for those who might be interested. Every physician

has his own pet preseriptions, treatments and equipment, and he would be expected to modify the basie list somewhat. The seeond manual grew with lists of reeommended trail or survival rations, personal survival gear and survival gear to be carried by polar aircraft.

In 1961, on the recommendation of LTCOL Merle R. Dawson, USA, Fort Eustis, Va., a most qualified, and certainly the author's most obliging critic, the third edition of "Antarctic Manual" was amended and in large part rewritten as "Polar Manual" in order to give it wider application.

From 1961-1963 the author served as Seventeenth Naval District Medical Officer in Kodiak, travelling and living extensively over central, western and northern Alaska. Increase in firsthand knowledge of the North, participation in the University of Alaska-Air Force symposium on injuries due to cold, and the faet that the Naval Medical School is running out of the 1961 edition, are factors dictating the need for the present revision. "Polar Manual" must again be revised and expanded to remain current and render greater serviee.

Speeific references are not annotated, for sueh would serve only to complicate and enlarge a working manual into a text, and defeat the purpose for whieh the manual is written. A bibliography has been added for those desiring further reading sources. In a field with a great many controversial opinions, it is hoped that the author may be pardoned for keeping a firm hand on the tiller of compromise.

For assistanee in making these manuals possible, the author is grateful: To RADM C.B. Galloway, MC, USN, for continuing encouragement in cold weather research and for assistanee in publishing the first "Antaretie Manual."

To Retired Admirals George Dufek, USN, David M. Tyree, USN, C.W. Thomas, USCG, R.B. Blaek, USNR, and G.J. Ketehum, USN; the late Sir Hubert Wilkins, CAPT Harry Kirkwood, RN, and Paul-Emile Victor, shipmates in the Antarctic; and to Vilhjalmur Stefansson, Donald B. MeMillan, and Bernt Balchen, whose friendships, precepts and advice have sustained his interest in this field.

To CAPT W.S. Lanterman, USN, MAJ Antero Havola, USA, and LCDR J.W. Potter, MC, USN, formerly of Operation DEEP FREEZE; Harry S. Franeis, Jr. and George R. Toney of the National Seienee Foundation; Palle Mogensen of the Aretic Institute of North America; Ernest A. Wood, U.S. Weather Bureau; William M. Smith, George Washington University; Dr. Bernard M. Gunn, Geology Department, Otago University, Dunedin, N.Z.; John Russell and his eohorts Lowe, Hunter, Hurley, Ponting, Griffith-Taylor and Rymill of the "Old Timers" Explorer Club of Sydney; Phillip G. Law, direetor of the Antaretie Division, Department of External Affairs, Melbourne, Australia, for constructive critieism and suggestions regarding Antarctie lore.

To CDR William Mills, MC, USNR, of Anchorage, and CDR Phillip H. Moore, MC, USNR, of Sitka, both veteran Alaskan physicians; COL Levi Browning, USAF, MC, (Ret), Commissioner of Health, Sitka, Alaska; COL Herbert Kerr, USAF MC, Surgeon, Alaska Command; LTCOL Fritz Holmstrom, USAF MC, and Dr. Fred Milan of the Air Force Aretic Aero-medieal Research Laboratory, Ft. Wainwright; and MSGT Keith R. Clemmons and A.K. Taylor and their colleagues of the outstanding USAF Survival Sehool, Eielson AFB, Alaska; Dr. Max Brewer, Direetor, Artic Research Laboratory, Pt. Barrow, Alaska; Commodore O.C.S. Robertson, RCN (Ret), Aretie Institute of North Ameriea, outstanding navigator of the Canadian Aretic; Squadron Leader S.E. Alexander, RCAF, former "Mountie" and former director of the RCAF Survival Sehool; Dr. Ove Wilson, University of Lund, Sweden, surgeon to the NBS Antarctic Expedition of 1952; Dr. Carl Wilhelm Sem-Jacobsen, former Arctic Commando, Oslo, Norway; for assistance in obtaining data sometimes peculiar to the Aretie.

To Richard K. Nelson, University of Wisconsin Anthropologist, my enthusiastie instruetor and contagiously eharming mess-mate on the Barter Island sea ice, for "Eskimology," and much of the expanded section on SEA ICE SAFETY.

To CAPT M.W. Arnold, MC, USN (Ret), and CAPT J.S. Shaver, MC, USN, former Commanding Officer and CAPT John H. Stover, MC, USN present Commanding Officer, U.S. Naval Medical School, for enthusiastic cooperation in the manual's revision and publication.

To his former assistants HMC J.F. Hartley, USN, of Operations NANOOK, HIGH JUMP, WINDMILL and DEEP FREEZE II, III and IV, and HMC Harvey E. Martin of DEEP FREEZE 60 and 61 for help in organization, preparation of reports, statisties and plans, and for their assistance in evaluation and re-supply of medieal materiel and equipment.

To Mrs. Ruby B. Carson, Mrs. Mary W. Gorman, and Mrs. Marjorie Bowker of the U.S. Naval Medieal School, Bethesda, Md., and Mrs. Peg Renn of Oak Harbor, Wash., for stenographie assistance.

Last, but eertainly NOT least, to his long-suffering wife and family who more or less eheerfully saw him off on the summer operations of five suecessive Antaretie expeditions (albeit the enthusiasm varied inversely with the number of departures) and then happily aceompanied him to Alaska in 1961.

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30 April 1965

TABLE OF CONTENTS

Page

LIVING CONDITIONS

Geography 1
Weather 2
Precipitation, Tides, Magnetic Storms 5
Static Electricity, Mirage, Light Whiteout 6
Natural Resources 7
Shelter 8
Heating 9

SELECTION OF PERSONNEL

Motivation 11
Age, Weight, Heart, Vascular System 12
Eyes, Ears, Nose, Throat, Skin, Psychiatric 13
History, Dental 14
Inoculations 14

PHYSIOLOGY

Circulatory Changes, Dehydration 16
Heat Regulation 17
Acclimatization 18
Heat Conservation 29

HYGIENE

Eyes, Ears, Nose, Teeth, Skin 19
Beards, Fatigue 20
Altitude Sickness, Alcohol 21
Tobacco, Do's and Don't's 22

PSYCHOLOGICAL ADJUSTMENT 23

"Big Eye," Headache 24
Group Attitudes, Readjustment 25
Morale 26
"Big I" 27
Leadership 28

HEAT CONSERVATION 29

Page

CLOTHING 30

Textiles 31
Underwear 35
Shirt, Pants and Inner Parka 36
Sweaters, Third Layer, Head 37
Sewing Notes 38
Hands 39
Feet 40
Sleeping Bags 41
Do's and Don't's 42

NUTRITION 43

Energy, Carbohydrates, Fats 44
Protein 45
Vitamins 46
Minerals, Provisioning 48
Cooking, Do's and Don't's 49, 131, 140

SANITATION

Water, Sewage and Garbage 50
Food Storage 51
Food Handling, Housekeeping, Infectious Disease 52

TRANSPORTATION 55

Driving the ALCAN 56
Sled Dogs 57

LOGISTICS 60

VISUAL DISABILITIES 61

Snowblindness 61
Whiteout 64

COLD INJURIES 66

Chilblains, Frostbite 67
Freezing 69
Immersion Foot (Trench Foot) 73
General Hypothermia, Immersion Hypothermia 74
"Frostbite" of Lungs, Carbon Monoxide 77
Anoxia 78

	Page
FIRST AID	79
INDIVIDUAL FIRST AID KIT	80
BASIC MEDICAL SUPPLIES	81
DENTAL CARE	87
SAFETY	91
Camp Safety, Cabin Courtesy	91
Travel in General	92
Direction and Time	94
Alpine Safety	97
Avalanche Safety	98
Glacial and Shelf Ice Safety	100
Crevasse Safety	101
Sea Ice Safety	102
"Eskimology"	104
Boat Safety	105
Gun Safety	106
Hunting Sense	107
Firearm Care, Animal Safety, Insects	108
Aviation Safety	110
Search and Rescue, Bailout	115
SURVIVAL	116
Housing	117
Survival Heat, Antarctic Stoves	119
Arctic Fires, Firebuilding	121
Fuel, Tools	122
Types of Fires	123
Fire Signalling, Warnings	125
Natural Survival Foods	126
Procurement	127
Survival Cooking	129
Survival Rations	131
Individual Camping Equipment	140
Aviator's Individual Survival Kit	142
Group Survival Gear	143
Ground-to-Air Signalling	146
POLAR DO'S AND DON'T'S	148
ANTARCTIC MORTALITY	154
BIBLIOGRAPHY	157

POLAR MANUAL

LIVING CONDITIONS

GEOGRAPHY

The Arctic Ocean and the Antarctic Continent are both areas of about 5,500,000 square miles. The polar and subpolar regions have been defined in many ways. The polar circles of 66°33' N and S define the areas within which are continuous daily sunlight in summer and continuous daily darkness in winter. Temperature isotherms define certain areas. The "tree line" defines other areas, dependent not only on temperature, moisture, winds, but also on altitudes. The Antarctic convergence where ocean currents of differing temperatures meet is another. The simplest definition is to call everything inside the Arctic circle "Arctic," and concentrically everything out to 60°N, "Subarctic." Conversely everything on the great southern continent may be called "Antarctic, " and the seas and islands out to 60°S, "Subantarctic."

ARCTIC

The Arctic Ocean is a "sound" of the Atlantic Ocean which communicates with the Pacific through Bering Strait, surrounded by the North American and Eurasian continents. This "sea" is divided by the Lomonisov or Harris Ridge extending from the New Siberian to Ellesmere Islands into two major basins, the western or Laurentian Basin averaging 10,000 feet in depth with two deeps of about 13,000 feet, and the eastern half comprised of the 13,000 foot Angara Basin with three deeps down to 16,000 feet, and the Greenland Sea and Norwegian Sea Basins of depth and with deeps similar to the Laurentian Basin. At the North Pole the Angara Basin is 13,484 feet deep.

The Arctic lands are, for the most part, low with marshy tundra, muskeg, and meandering rivers which thaw in the short warm summers making overland transportation virtually impossible. This area has permanently frozen ground or "permafrost" from a few to hundreds of feet deep under it. In a few places the Arctic is rocky, mountainous and glacial - Greenland, Ellesmere and Baffin Island, Northern Alaska, in places along the Norwegian and Siberian Coasts, and in the islands north of Siberia.

ANTARCTIC

Antarctica, highest of all continents, averaging over 6,000 feet in elevation, is completely surrounded by the Atlantic, Pacific and Indian Oceans. This mountainous land of ice and snow contains 85-95% of the World's glacial ice which if melted would raise all the seas of the earth by 100-200 feet, depending on who figures it. It is divided by the (Pacific) Ross Sea, the (Atlantic) Weddell Sea, and a

questionable land trough beneath 5,000-6,000 feet of ice into the greater East Antarctica, a 13,000 foot domed ice cap, and West Antarctica, a lower ice plateau dotted with mountain ranges some of which are geologically continuous with the Andes of South America through the Scotia Arc and the Palmer peninsula of Antarctica. This land has one active volcano, Mt. Erebus on Ross Island at the northwest corner of the Ross Ice Shelf. This is one of many peaks over 13,000 feet high, dwarfed by Mts. Kirkpatrick, Wade and Markham, 14,600, 15,000, and 15,100 feet respectively. The South Pole lies on a plateau at 9200 feet elevation - beneath lies 7500 feet of ice and 1700 feet of earth.

WEATHER

ARCTIC weather is tempered by the central ocean which acts as a reservoir of heat in winter, and a cold repository in summer. As a general pattern it has monsoon type weather with anticyclonic highs north of Siberia and north of North America and lows over the Aleutians and Iceland during the winter. In summer the highs are not so violent and the loci of areas are roughly reversed. Warmer summer temperatures melt much of the subarctic snow cover, and resulting stratocumulous clouds over the Canadian Arctic give icing conditions for flying, with winds more variable and less strong. In the fall wind velocities increase, and frequent storms, fog, and low ceilings cause the worst flying weather of the year. In January come high winds and snows with fair flying weather over Alaska, but many clouds and much fog in the Greenland-Hudson Bay area. Spring gives best flying weather, cold and clear over Alaska, but occasional "cold lows" may bring clouds to the W. Greenland area for periods of 1-2 weeks. Fogs and clouds are more common in summer and early fall, occurring over newly thawed coasts and over large bodies of water. Sea smoke or ice crystalline fog is most common in the S-W Greenland area during winter, occurring over open leads in the polar pack with low temperatures and light winds. Blowing snow (blizzards) is worse after fresh fall before cold temperatures have crystallized and fixed it into heavier "neve," or warmer temperatures have caused surface crusting. Drifting begins at winds of 10-15 mph. At 30 mph visibility usually goes down to about one mile. At 40 mph and over visibility is only a few yards.

The north pole is not the coldest part of the Arctic. Coldest official northern temperature is -90°F. recorded at Verkhoyansk, Siberia (132°E, 67°30'N), although Oymyakon (143°E, 63°20'N) nearby claims -105°F. Both of these towns are in valleys in mountainous areas where extreme cold descending from heights above will "dam up." Both towns have some summer agriculture.

Sea ice of 4-10 feet in places rafted to 30 foot hummocks by pressure of motion covers the Arctic Ocean. (There is 75% coverage even at the end of the warmest summers.) This ice is in constant clockwise motion from Siberia towards Greenland and thence toward the Bering Strait. Ice islands which have been used for much Arctic research are thicker, fresh water tabular (flat) icebergs, cast into the sea by the glaciers of north Ellesmere Island.

ANTARCTIC weather is dominated by cold roughly 30°F colder than the Arctic, and by low barometric pressures. Generally speaking the Pole has a continuous low pressure, which accounts for earlier estimates of its altitude as being 10,000-10,15000 feet. This polar low, however, is high compared with the cyclonic lows which circle the continent from west to east in the area roughly between 65° and 70° south. These "low lows," in spite of the fears they throw into a neophyte northern meteriologist or skipper who observes the barometer fall to unheard of depths, do not necessarily mean bad weather as they would elsewhere. These "low lows" with the adiabatic cold air currents descending from the polar cap (causing winds up to 100-200 knots in the "Land of the Blizzard" where average annual wind at Mawson A.N.A.R.E. station is 30 knots) and with the prevailing westerly winds and currents of the southern oceans produce the roaring forties, the furious fifties, and the screaming sixties of seafarer fame.

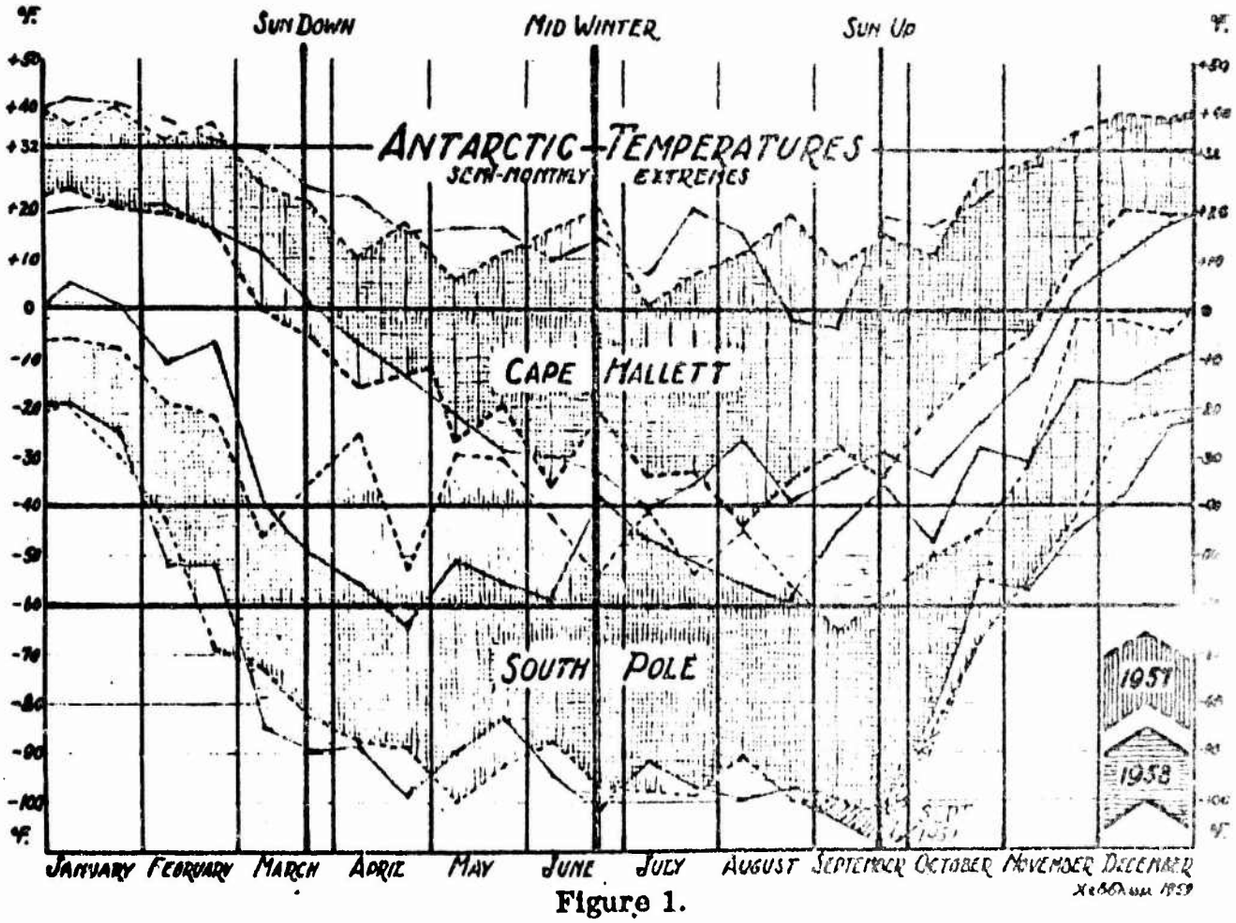


Figure 1.

Figure 1 shows the remarkable temperature spread of two bases in Antarctica. Because the warmest temperature at the South Pole on two occasions was the coldest temperature at Cape Hallett, the more sophisticated "pole cats" accuse their brethren at Hallett of living in the "Banana Belt."

Figure 2 illustrates that on Arctic and Antarctic bases of roughly the same

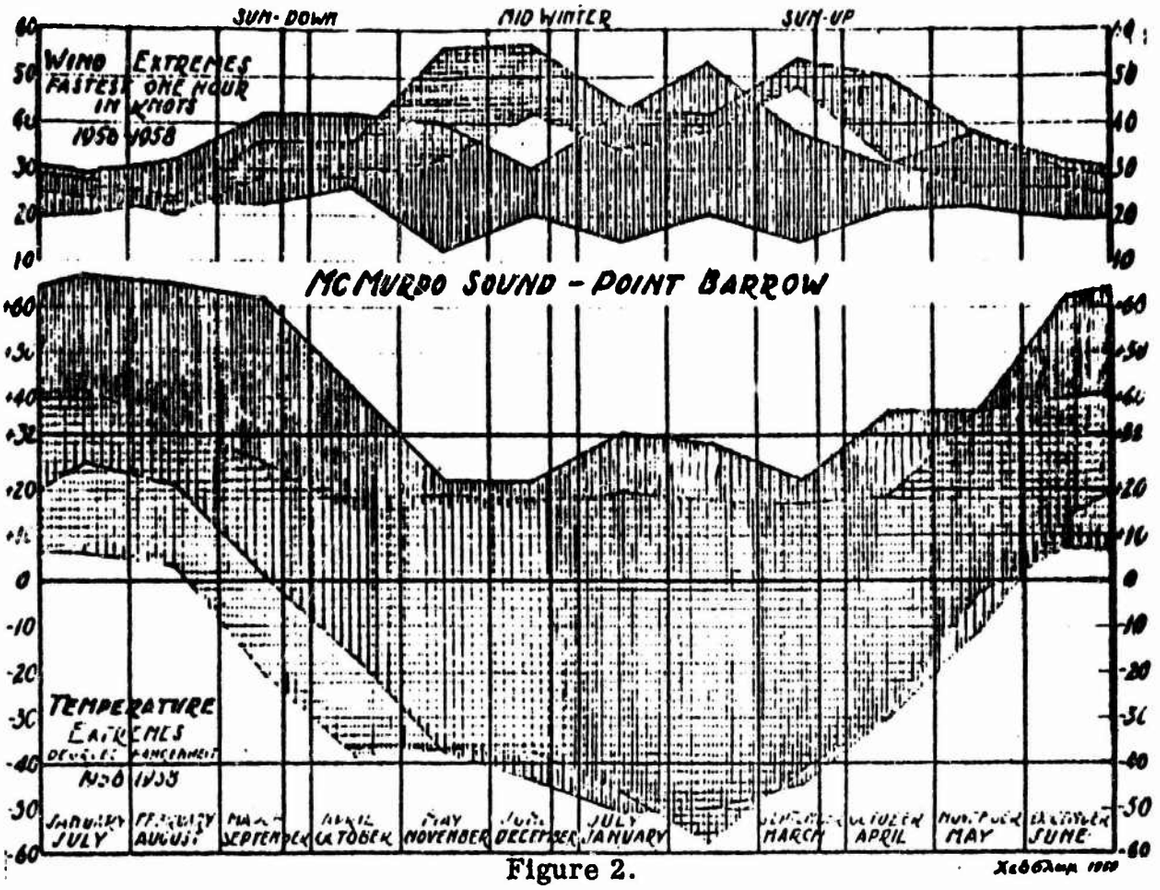


Figure 2.

latitude, both tempered by sea on one side, the Antarctic is uniformly colder, rarely rising to thawing temperatures during the summer. It also indicates the generally higher and more constant winds in the south.

The coldest recorded temperature to date in Antarctica was made by the Russians at Vostok station in August 1960 when the temperature sank to -126.9°F. Generally speaking, both north and south, when the temperature falls, so do the winds, and visa versa. Blizzards are blinding and men must "hole up" but temperatures are never the coldest for that area or time of year. Interestingly, it has been observed that at depths of about 50 feet in Antarctic snows, the year round temperature is the same as the average means annual temperature, e.g., at Little America III, fifty feet below the surface of the Ross Ice Shelf the temperature is -27°F, and at the South Pole the temperature in the bottom of the snow mine was -65°F. For man's comfort the temperature-wind relationship is MOST important in both regions, and this will be discussed further under "CLOTHING."

The sea ice of Antarctica is similar in thickness to that of the Arctic, except that it lies around the continent roughly as a barrier reef surrounds a mid-Pacific island. In winter this is continuous from 60°-65° south to the continent. In summer it melts somewhat at the periphery of the continent, giving variable sized areas of open sea between pack and shore. As the sea ice of the Canadian

Arctic tends to move west and south leaving eastern shores relatively clear, so does the ice of the Weddell sea, giving it a clockwise motion with heaviest summer ice pushed up against the Palmer Peninsula to the west. The Ross sea is most likely to be open at the 180th meridian in summer, with pack ice to the west of 170°E and to the east of 160°W usually until late in the summer season. Its breakup cannot be depended on seasonally.

PRECIPITATION

Generally snowfall at both ends of the earth is limited to 6 inches to 18 inches annually. The Subarctic has some rain, the Antarctic most rarely has rain, but the annual precipitation of both areas is so little as to make them relative "deserts." Because of uniformly colder and windier Antarctic weather, snow blows more often, more constantly, and more violently making the Antarctic blizzard most horrendous.

TIDES

In the Arctic basin and around Antarctica most tides are barely preceptible and have little effect except to free the sea ice from the shore along tidal cracks, and to cause mild currents along bays and fjords. In the Subarctic tides sometimes rise and fall as much as 50 feet making camping near shore and handling of small boats extremely hazardous.

MAGNETIC STORMS

In both polar areas, within 48 hours of the appearance of giant sunspots, there is remarkably increased bombardment of the earth and its atmosphere with cosmic irradiation which gravitates toward oval "doughnut"-shaped areas of inner radius 600-900 miles and outer radius 1000-3000 miles around the two geo-magnetic poles. (North 78°6'N, 69°W and South 78°S, 111°E). These storms appear to be cyclic, about once every 27 days.

These storms have a number of effects. The disturbance of the ionosphere which reflects radio waves causes radio "blackout" for periods of hours to days, with higher frequencies suffering more than lower frequencies. (Frequencies less than 200 Kcs may actually improve during "blackout.") UHF frequencies return first, but all transmissions following the earth's magnetic fields will have 3-4 times greater range than those at right angles to it.

The second most remarkable phenomenon associated with these storms is the Aurora Borealis of the north and the Aurora Australis of the South, nocturnally visible in the above described "aurora belts." Apparently charged hydrogen particles from the sun light up the upper atmosphere like a neon light with yellow, green and occasionally red lights in a number of curiously shaped patterns.

The effects of these increased bursts of cosmic irradiation on man and other biological forms leaves much room for speculation, although it appears at this time that the polar regions might not be so dangerous from this standpoint as Peru, Colorado, and Switzerland, where people remain healthy and happy for a normal lifespan at altitudes in excess of 8,000-10,000 feet in spite of marked increase in cosmic irradiation.

STATIC ELECTRICITY

The motion of snow over steel cable, plastic (nylon) rope or electric cable generates large charges of static electricity, whether by helicopter slipstream, blizzard, or by the line being dragged over the snow. This can be dangerous, and/or disconcerting in helicopter operations, in tending radio masts, and in trail operations. In laying blasting charges always unroll, NEVER drag the wire, and ONLY AFTER blasting cap detachment. Beware static in nylon lines, tents, and clothing—it might spark a fire.

MIRAGE

Polar "deserts," like tropical ones, have frequent stratified temperature inversions causing mirage, with upright or mirror images of objects ordinarily not visible around the earth's curvature. Cold clear air, free of moisture, and smog enhance mirage visibility. This explains navigational errors in land sightings of early explorers.

PRISMATIC LIGHT

Sun shining through stratus clouds of ice crystals cause bewildering and beautiful optical phenomena, down-sun "ice bows," mock suns (sun dogs or parhelia), and double halos around the sun (parselenes) with bands and circles of colored light. Moonlight through these clouds give beautiful double coronas. Cloudy sunrises and sunsets are indescribably beautiful.

WHITEOUT

This is a daylight optical condition occurring on snowscapes with nearly completely snowy obliteration of nature by freshly blown or fallen snow, with the sun's rays diffused by altostratus or cirrostratus clouds. Transmitted light is reflected from snow to cloud to snow, back and forth with increasing energy until everything is diffusely lighted with nonpolarizable light. The horizon partially or completely disappears, sastrugi (snow waves), crevasse bridges, and all tracks become invisible because shadows become imperceptible without special glasses. Nearsighted and dimmer vision cause loss of depth preception and disorientation, with dog dung becoming distant mountain peak and sardine can becoming massive fuel tank.

This occurs in absolutely clear ground conditions, not depending on other conditions causing limited visibility, fog, sea smoke, blowing snow, or falling snow, although any or all of these conditions may be concurrent with whiteout in one or more quadrants of the horizon. It is common in Alaska in late winter or early spring, and on the Greenland Ice cap and Antarctica whenever the sun is up.

NATURAL RESOURCES

Antarctic climate naturally limits plant life to a few hardy lichens, mosses and algae. There are no trees to furnish fuel and shelter, and no edible roots, leaves, or berries as in much of the Arctic. Fuel in the Antarctic interior must be carried. On the continental periphery the fat of seals or penguins is the only natural fuel available.

In much of the Subarctic hordes of flies, mosquitoes, and gnats plague man. In the Antarctic insect life is limited to a very few wingless species that live in lichens or in penguin "nests" from year to year.

The Arctic explorer should be armed for protection from the polar bear and wolf, and in order to kill seal, musk ox, caribou, or birds for food, fuel, and clothing. Hand arms are for the most part useless weight in the Antarctic, for they little harm the killer whale; the sea leopard is quite rare; and, although somewhat dangerous during mating season, crabeater, Ross, Weddell or elephant seals can be clubbed if needed for food.

The North is the nesting place for many varieties of edible birds with edible eggs. The South has the Emperor and Adelie penguins - a fat, fishy meal cooked under survival conditions, the snowy petrels found on the sea ice, the south polar skua, an eagle-beaked gull-footed scavenger of general distribution, and petrels, fulmars, terns, gulls, whale-birds and the blue eyed shag, all sea birds which nest in the Palmer peninsula and the subantarctic islands. The flying birds are few in species, many in numbers, but are wary and hard to catch.

Fish are a food staple to the numerous people living north of the Arctic circle; fish south of the Antarctic circle are few in edible species, few in numbers, and difficult to catch. Fishing in Antarctica is better for morale than for the larder.

In the Arctic, seals were observed by Papanin within 15-20 miles of the Pole and people in numbers have lived for thousands of years within 1200 miles of the Pole. In the Antarctic (with the exception of an occasional skua gull in flight) plants and animals are found no closer than 800 miles to the Pole, and the closest native inhabitants live 2,000 miles from the Pole.

The Arctic has a history of 400 years of extensive exploration and exploitation -

the Antarctic has been only superficially explored since its discovery 120 years ago, until the impetus of the I.G.Y. 1957-58.

SHELTER

A. Tentage. Modern summer parties camping or on trail (December, January and February) have used double-wall tents for shelter. These are usually hard to pitch, almost always too small for the rated number of occupants, hard to maintain in high winds unless properly ice blocked, and hard to heat safely or efficiently. The double-walled pyramid tent used by English, New Zealand, and Australian trail parties is easy to pitch, is said to withstand 80-100 knot gales, and can be warmed to some degree by 1 quart of kerosene per day. The Russians, Japanese and Swedes use hemispherical igloo-shaped tents which would seem to give more utilizable floor space, and minimize loss of heat in the peak. Tents should be of half cotton, half nylon "ballcon" cloth which neither flames like pure cotton nor melts (and cannot be easily sewed) like nylon. Ventilation must be adequate! They should have adequate skirts for proper ice blocking vs. wind. For protracted trail use sleeve entrances opened from inside or outside must be incorporated. Zippers, tapes, or botton closures should not be utilized for winter or Antarctic tents. Pitching the tent with entry across the wind line avoids blockage with drifting snow. Tents must be scrupulously brushed free of snow and frost after each use to keep them free of ice, light, and easy to pitch.

For summer use in the Subarctic, tents must have efficient and fine netting over entrys and ventillation hatches if the occupant hopes to sleep in spite of the insects. Iron tent pegs are required for use on permafrost or Antarctic ice.

B. Wannigans or Cabs. Most modern traverse (trail) parties use towed buildings on sleds (wannigans) or enlarged cabs on tractors of double wall plywood or metallic construction with varying types of insulation. These are heated in many ways (see below) and are comfortable although quarters may be quite cramped. Sno-Cat cabs are difficult to heat and to dry clothes in. Tents are preferred by many for sleeping on Sno-Cat traverse.

C. Housing. Permanent installations usually are of double plywood or metal walls, insulated and quite air-tight. Air lock doors are usually provided to conserve heat. Double plexiglass ports provide light in summer. American types in use as mess halls, barracks, heads, laundries, utility buildings, hospitals, recreation buildings, etc., are the rectangular (T5) and the Butler, both of which are preferred to the Clements House because of their slightly peaked roofs which shed melt water, and Quonset (2 sizes), Clements, and Jamesway huts (all hemicylindrical). Painting buildings white reduces melt, slush, and settling in the North. When built on snow, ice, or permafrost, buildings, particularly those used for cooking, need adequate insulation between deck and outside environment. All permanent housing should have vestibules at both ends of all buildings, with doors opening at

right angles to the prevailing wind. This conserves heat, and the doors are less likely to drift in.

Principal problems with these buildings are heating (see below), ventilation and humidification of air. Adequate ventilation over a spread of 100°F annual temperature variation demands two-way fans with controllable diaphragm aperture in at least both ends of each building, yet this is not conservative of heat.

Outside air at 0° to -110°F with relative humidity up to 80%, when warmed to 70°F has a fraction of 1% relative humidity. Without 25-50 gallons of water per day per 10,000 to 15,000 cu. ft. of building (used in evaporators or humidifiers) the air cannot be brought up to the 25 to 30% relative humidity necessary to prevent sore throat (pharyngitis sicca) and much dry bronchial cough.

D. Ice and Snow Shelters (See Survival Housing)

HEATING

Up to 1940 most heating of spaces and heat for cooking came from coal. At present the following heat sources are in use, or are contemplated:

A. Fuel Oil - dirty, fairly hard to handle, sooty flame. Gives frequent flue blockage (with subsequent backfire) and snow contamination. Necessary for electric power diesels and diesel tractors.

B. Gasoline - inherently fire hazardous. It should be used only in aircraft survival stoves. Has been the cause of many fires on bases.

C. Kerosene - used commonly in trail primus stoves and heaters on some bases. Sooty, smelly flame with disadvantages of fuel oil, but to a lesser degree.

D. Alcohol - used in small stoves and as source of laboratory heat. Clean flame, not malodorous, not fire hazard; may create personnel problems from imbibition of fuel. It is hard to light at low temperatures.

E. Bottled gases - methane, ethane, propane, butane - efficient sources of heat but inherently dangerous in closed spaces both from explosion and asphyxiation.

F. Diesel - electric - wasteful of fuel and energy although there are a few limited uses in hot water heaters, etc.

G. Atomic pile hot water-electric. Though expensive, this might be more economical in the long run for permanent installations. (One 11¢ gallon of fuel oil delivered to the South Pole costs from $2.50 to $5.00 per gallon.)

The average American home in winter, with central heating, is kept from 72°-76°F. ideally, although they sometimes get up to 90°F. In the rest of the world dwellings, mostly without central heating, are more often 55°-70°F.

At lower temperatures (a) fuel is conserved, (b) the relative humidity is higher, (c) man will tend to acclimatize, and (d) sweating with high incidence of upper respiratory infection on going outdoors is prevented. The Russians emulating the Eskimos wisely recommend temperatures of 64°-66°F. as ideal for polar dwellings. We should emulate them. A night temperature of 40°-50° with added ventilation promotes sounder and safer sleep.

A big kettle which can be filled from time to time with snow on top of each space heater:

a. Conserves heat
b. Augments the supply of fresh water for washing, etc.
c. Increases relative humidity in the extremely dry building interior.

For temporary camp use in heating tents:

a. Herman-Nelson heaters burn 4 gal. gasoline/hour, are hard to start, heavy, and often suffer malfunction producing dangerous amounts of carbon.

b. Army Stove M1941, an 18" x 18" "beer keg" burns 1/2 ton of coal/week or 1/4 gallon of gasoline/hour.

c. The Yukon Stove, 8" x 8" x 24", weighs 23-1/2 lbs. with all accessories including stack, burns wood or coal, or with attachments burns liquid fuel at the rate of 1 gallon/3 hours.

No matter how a polar dwelling is heated, unless many high power fans are used, the temperature will vary from 20°-50°F. at the floor to 60°-100°F. at the ceiling. Men in lower bunks use one to two more blankets than men in upper bunks. Clothing always dries quicker in the "overheat." This is not incompatible with health - men quickly learn to wear warm footgear, moderately heavy trousers, and a thin shirt (or no shirt) to compensate.

SELECTION OF PERSONNEL

MOTIVATION

Motivation is the most important single factor in selection, and high motivation is the chief asset of polar candidate. Good motivation furnishes the mental flexibility necessary to CHEERFULLY meet long periods of boredom, drudgery and sometimes hardship, interspaced with occasional periods of emergency or terror. Why do men go to the ends of the earth? For many reasons.

Desirable are those who go with a specific interest, to be professional explorers, for scientific research, or the adventurous pioneer-mountain climber type who HAS to go "just because it is there." Less desirable because they are early and easily disillusioned are the idealist, the ambitious, and the glory seeker.

The "escape artist" is harder to spot, and he is usually either a good man or almost totally useless on the ice. Some evade family troubles with sweethearts, wives, or in-laws. Some evade responsibility, legal, financial, social, or familial. Some go to get away from a "lousy" duty station.

Least desirable and most difficult to weed out are those with strong subconscious suicidal, homosexual, martyr, sadistic, or masochistic complexes to whom a rugged life of isolation sometimes appeals. Disillusion removes all reason for being there, and they become dangerous to themselves and to others.

The "drifter" with nothing else to do at the moment may be pushed or persuaded into an expedition, and surprisingly often is a good man, for his dearth of anxiety, emotion, and preconceived ideas, and the charms of isolation and beauty of polar regions puts reason in his being.

"Money savers" are of two types, the admirable who save for education or to pay debts, and those who splurge quickly on their return. They behave the same way on the ice.

Probably most happy on the ice is one "escape artist," the rugged individualist who finds modern urban life intolerable with its TV and newspaper ballyhoo of sex, togetherness, world crises, and crime; a frustrating hurry, hurry schedule of clock punching work hours, and frantic recreation stimulated with benzedrine, caffeine, and tobacco, narcotized with tranquilizers, alcohol and barbiturates, flavored with jungle wailings called jazz; and anxious, noisy, noxious bumper to bumper traffic in between. Many men who have never met the Almighty in church, meet him occasionally at the operating or delivery table, but really get to know him at the ends of the earth.

AGE

Naturally the younger, stronger, more active man has a better chance for survival in the cold, other things being equal. He acclimates more readily. He has not acquired the varicosities and arteriosclerosis of age which predispose to cold weather injury. His musculature is proportionately greater giving him a greater source of heat production. He is more likely to be free of physical defects. The older man, however, often has sagacity, motivation, and philosophical attitudes lacking in the younger. Other things being equal, isolated polar duty best fits men 25-45 years of age.

On small stations (10-30 men) compatability is more important than great skill. Young men with lower ratings (2nd or 3rd class petty officers) often are quicker to do necessary tasks, out of rate, yet for the common good, than are the more highly specialized Chief and first class petty officers. Teen-agers are often a logistics problem in that rarely can their appetites be satiated for long.

WEIGHT

The obese man usually is poorly muscled and lacks the stamina necessary for cold weather survival. He is a potential cardiovascular casualty. The overly thin man may have undue tendency to suffer from the cold. The big man has a bad reputation in the Antarctic (Evans and Mertz) but it is believed that he is no more liable to freeze or starve than the small man if proportionately fed. The average New Zealnders on Antarctic survey parties (and there are no tougher men) are over 6 feet tall, well fed, but not obese.

HEART

History of heart disease should rule out any candidate for the cold because these diseases damage the heart valves and muscle making the "pump" inefficient predisposing to further strain with cold acclimatization and to cold injury of extremities. Cyanotic, pale, hyperemic mottled or hyperhidrotic hands or feet are similarly signs of poor circulation or psychosomatic imbalance and are in almost all cases disqualifying.

VASCULAR SYSTEM

Diseases which in themselves impair circulation and thus predispose to cold injury should disqualify. The aforementioned colors of hands and feet may also indicate cold urticaria, Raynoud's disease, or Buerger's disease, all of which, or family history of which, should disqualify.

EYES

Visual acuity should be sufficient that should a man break his glasses, he

would be able to find his way back to camp unassisted, for his own sake, and to prevent his being a burden to his comrades during an emergency. Arbitrarily the U. S. Marine Corps enlisted standard of a minimum of 20/70 in one eye and 20/40 in the other, both corrected to 20/20 by glasses seems reasonable. Color blindness should disqualify only pilots, trail personnel, and certain scientists, e.g., aurora observers and electronics technicians whose duties demand accurate color perception.

EAR, NOSE, THROAT

Any signs of past chronic inflammation of the ears, nose or throat such as scarred or perforated drum, marked loss of hearing, sinus surgery or impairment of breathing passages should rule out the candidate. Normal people with normal ENT histories have enough trouble in extreme cold! (Incidentally, one need not be a snorer to be an explorer. Many are. Post hoc, ergo propter hoc?)

SKIN

Skin grafts of face, hands or feet, and cold urticaria with or without hemoglobinuria, and chronic skin diseases such as scleroderma and acrocyanosis are disqualifying. History of previous severe frostbite with loss of bony or cartilaginous tissue will disqualify.

PSYCHIATRIC

No psychiatric case ever got better in the cold. In fact, many people able to adjust to society in temperate climates, become asocial in the monotony, isolation, and limitation of mobility which is the lot of the majority living within the polar circles.

In spite of the fact that a number of men who have successfully weathered one or two previous expeditions have become psychiatric casualties on subsequent expeditions (ALL men have their breaking points), the best indicator of a man's suitability for this type of duty lies in what his fellows on previous ventures think of him as an individual, as a messmate, or as a fellow camper.

Second best method of evaluation is a psychiatric interview by a physician who has lived on the ice. This should be done at the time of physical examination, so that the rejected may not suffer irreparably damaged egos or the social stigma of being considered mentally unfit. Obviously the signs of major psychoses disqualify. Other disqualifying characteristics are (a) history or strong suspicion of homosexuality or transvestitism, (b) enuresis or somnambulism during the past ten years, (c) past suicide attempts, (d) a history of periodic or behavioral "stress" drinking, and (e) filth (physical, sartorial, or verbal).

Signs of serious psychoneurosis, though rarely disabling, will always make the

man a problem, should disqualify. These are composite pictures of two or more of the following symptoms: (a) too slow or overactive behavior; (b) inappropriate, exeessively loud, or irritating laughter; (e) notable anxiety when others feel little tension as evideneed by perspiring hands, habitual nail biting, ties, habit spasms, stuttering, overt suspieion, diseontent, or resentment; (d) repeated legal diffieulties; (e) repeated VD; (f) habituation at military siek call; (g) the overly religious; (h) the overly conseientious who must "do things right now;" (i) exeessive worriers; (j) insomniaes; and (k) those frequently suffering from terrifying nightmares.

The quiet, retiring, sometimes shy or seclusive man might be considered antisocial by "civilized" standards, yet these "hermits" are often pillars of strength and wisdom in a polar community.

HISTORY

History of potentially serious, chronie, or ehronieally reeurring eonditions whieh may eause undue burden on the neeessarily limited medieal faeilities should rule out all sueh applicants. This ineludes serious head injury (uneonseious one hour or more), reeurring headache or baekache, peptie uleer, gallbladder disease, kidney stone, chronic pyelitis, syphilis, osteomyelitis (unless cured for five years), eaneer, "ehronic" appendieitis (unoperated attaeks of right lower quandrant pain), endocrine dyscrasia, release from hospital with major surgery, fracture, illness, or diagnostie problem within the past six months, and history of hospitalization with or without surgery for ehronic ear, nose, throat, sinus, or mastoid infection within the past ten years.

It is eonsidered prudent for physieians going to isolated polar duty to have a prophylactie appendectomy before departure.

DENTAL

Dental examination should reveal no untreated earies or nonvital teeth. Prosthetic replacements should be sound and allow eomplete biting and ehewing functions. The majority of personnel will receive only emergeney dental eare at the hands of medieal offieers for a period of about one year, and in the Antarctie faeilities are not always available nor will operations permit brushing of teeth when they need it. (In Alaska the military have more trouble with dental conditions than with anything else on remote sites. It has been suggested that the ideal mouth is one whieh a dentist would wager $1,000 that no trouble would oeeur within an 18-24 month period.)

INOCULATIONS

The following disease preventive inoculations have been routinely used on

Operation DEEP FREEZE with satisfactory results:

a. Smallpox (cowpox) inoculation within past 12 months.

b. Tetanus inoculation or booster within past 12 to 24 months.

c. Diphtheria (for those under 40 years of age).
NOTE: b. and c. above may be used in combined toxoid.

d. Typhoid within past 12 to 24 months. (This is particularly indicated for those going to the Arctic.)

e. Poliomyelitis (for those under 40 years of age).

f. Yellow fever (for those going via the Panama Canal Zone).

Use of influenza vaccine is certainly in question in the author's mind. During the pandemic of 1955-56 and 1956-57 no influenza inoculations were used on the DEEP FREEZE expeditions, and the upper respiratory infection rate of the first two expeditions was well under that of the U. S. Navy at large. Prior to DEEP FREEZE III, IV and 60 in 1957-60, influenza inoculations were routinely used prior to arrival in New Zealand, and the result was that on the latter three expeditions the upper respiratory infection rate was equal to or higher than that of the Navy at large for these two years.

COLD PHYSIOLOGY SIMPLIFIED

Individual differences in race, anatomy, physiology, physical condition and psychological attitude toward cold based on past experience probably explain the wide variation of response of the untrained toward the same cold experience.

Circulatory Changes

When man is subjected to cold, reflex constriction of peripheral arterioles allow less blood to flow to the skin surface, thus minimizing heat loss. This effect is accentuated by a secondary vascular constriction caused by increased circulation of adrenalin with "stress." If man does not fear sudden chilling, then he usually has some apprehension for the dangers and strangeness of polar environment, and apprehension causes increased suprarenal activity. This is born out by the expression "cold feet" and by the common observation that the first week or month a man spends in polar regions before his apprehension turns into a healthy respect, he dresses much more heavily than do the old timers. This explains the belief of many that man acclimatizes to the cold.

Because syncope (fainting) and shock are more common and more profound following injury in the cold, some observers have warned that adrenalin should not be used in cold climates. Our observations in Antarctica showed no untoward reactions in inside workers or in those more likely to be acclimatized, and we continue to find adrenalin useful, particularly in conjunction with local anesthetics. Having all patients (particularly those who have been injured while working out-of-doors) lie down during examination and treatment prevents fainting due to psychic factors and to vasodilation with drop in blood pressure on coming inside.

Dehydration

With peripheral arterial constriction, cardiac output is increased, blood pressure and pulse rate rise, and urinary output is increased. Excessive drinking of hot coffee, tea, and chocolate stimulate kidney function. Add increased water loss due to inspiratory hydration of extremely dry polar air, and alarming dehydration sometimes occur. Deep orange or brown concentrated urine causes dysuria (burning), urgency, and frequency of urination. Concentration certainly predisposes to kidney and bladder stones. Dehydration contributes to polar constipation, hemorrhoids and headaches.

Man needs about two quarts of water every day to maintain normal excretion, both urinary and bowel. Because thirst is not always increased too much, because it may be inconvenient to stop to melt snow or ice for water, or because fresh Arctic summer water should always be purified chemically or by boiling, there is a tendency not to drink enough water.

Heat Regulation (Physical)

Newton's law of cooling states that the rate of cooling of a body warmer than its surroundings is proportional to its surface area, and to the difference in temperature between the hot body and the cooler surroundings. In man this heat loss occurs by convection due to air currents next to the skin, by radiation or infrared emanation from the skin independent of air movement, and by conduction which is an insignificant molecular heat exchange unless the man is unwise enough to touch bare metal or immerse his hands in a solution of alcohol or gasoline at subfreezing temperatures.

Physical cooling is regulated by the circulatory changes explained above, and by sweating in case the man becomes overheated. This heat is lost normally in the following proportions:

1. Direct loss from the body surface, 63-7-%
2. Insensible skin perspiration, 14-18%
3. Saturation of inspired air with water vapor, 8-9%
4. Warming of inspired air, 2-9% (at -40°)
5. Warming of foods and fluids ingested to the temperature of the excreta, 1% or less

Heat Regulation (Chemical)

This concerns the production of greater or lesser amounts of heat principally through the oxidation of carbohydrates in the body musculature. When man is at 82°F. in air or at 91°F. in a water bath, there is a call for extra heat production. The colder the man, the more production. The more physically fit the man, the more efficient his heat production.

Muscle heat is produced by normal contractions of exercise, in the cold by increased muscular tension or tonus, and when the body core or inner temperature falls from about 99°F. to as low as 64.4°F. (the record low from which an intoxicated Negro woman recovered) by shivering. Increased tonus and shivering are involuntary.

If while on the trail or working outdoors one gets so cold that involuntary shivering ensues, heat production can be increased by as much as 20%, by tensing opposing muscles without making motion or doing work. This is a temporary expedient which may bring on fatigue rather quickly, so don't overdo it.

It is believable that significant heat is produced by the body's chief chemical plant, the liver. This seems borne out by the remarkable number of men in Antarctica who have developed liver enlargement without evidence of disease or gross alcoholism.

Shivering is depressed by anoxia (carbon monoxide from smoking as well as from motors, and altitude cause this), by antipyretics such as aspirin, by the magnesium ion, by insulin, and by anesthesia or narcotics (including alcohol).

The entire heat regulating mechanism, chemical and physical, is depressed by anesthetics, narcotics, sleep, fatigue, and shock (get that injured man into a warm sleeping bag as soon as possible).

Chemical production of heat is under the control of the thyroid gland which controls the Basal Metabolic Rate or the rate of oxidation in the body. Physical control is to some degree under the suprarenal gland. Both thyroid and suprarenal are under the control of the pituitary. Both glands hypertrophy or grow somewhat larger in the cold.

Acclimatization

The body's response to loss of core temperature is shivering. This is inefficient, for with the increased heat of involuntary muscular contraction, there is an increased blood circulation with further loss of temperature. In experimental cold chamber studies, after exposure to temperatures 52-54°F. (year-round temperature of temperate zone natural caves) eight hours daily, subjects were found to have 30-40% increased heat production, diminished shivering after two weeks, and drop in core temperature of 1°C. (2°F.) after 30 days.

Eskimos, Indians and Newfoundland fishermen who have their hands in cold water a good deal have remarkable subjective tolerance to cold hands. They develop a greater circulation to the hands which brings more blood and warmth to the fingers. Of course, this calls for greater core heat production.

Dr. Edward Wilson and Birdie Bowers, participants in the "Worst Journey in the World" and in Scott's fatal haul to the South Pole took slush baths every day on arising in preparation for their journeys, and they developed remarkable subjective and objective resistance to cold. This might be a histamine-antihistamine reaction.

Those who swim in cold water or who stay (sensibly) barely warm enough for comfort develop a thickening of the normal layer of subcutaneous fat improving insulation of the core temperature.

The BMR of Eskimos have been measured by many workers, and in almost all cases it is found elevated over whites living in the same area. Whether this is part of acclimatization or whether it is due to high protein diet (see Nutrition) is still debatable.

If man does truly acclimatize to the cold in some of the above ways, the

process probably takes one to three months of life on the trail or of repeated severe daily exposures with intermittent temperatures not over 70°F.

HYGIENE IN THE COLD

Eyes

There is no natural adjustment to the glare of bright sunlight during polar summer or alpine winter, when reflected from snow, ice or water, even with overcast sky. The longer invisible light waves (infrared) cause optic fatigue and a remarkable eye discomfort the author has described as "calorophthalgia."

There is no natural resistance or acquired immunity to snowblindness caused by the short invisible light (ultraviolet). Once snowblind there is a predisposition toward recurrence with less than the original exposure for periods up to five or six years. In sunlit snowscapes man must protect his eyes with dark glasses at all times.

Ears

Ears are very cold sensitive and must have adequate protection, particularly when it is windy. Drums sensitive to cool winds may be protected with a small plug of cotton or soft tissue paper lightly put in the outer ear canal.

Nose

In the cold your nose will drip. This is not a head cold; it is natural. Don't rub it with a dirty hanky - use your finger or soft absorbent paper.

Teeth

Brush your teeth regularly with a fluorine-containing dentifrice. Avoid sticky sweets. Take a multiple vitamin capsule every day.

Care of Skin

Soaking in water, excessive sweating, or excessive bathing with soap destroys the supercooling phenomenon of the skin whereby dry skin or skin with its natural oils may be cooled from 0°C. (32°F.) down to -5° to -7°C. (20° to 23°F.) for a time before frostbite begins. (This is the "critical" temperature.)

Bathing with soap every one or two days at Little America in 1956 produced over 150 sick call visits for skin ailments. With the same number of men (120) at McMurdo Sound the same season, bathing every seven to ten days was correlated with only three cases of skin ailment. Because of the excessive dryness

of the atmosphere, the skin does not stay normally oily. Oiling or greasing of the skin has been reported to (a) make the feet stay wetter in footwear; (b) soften excessively dry, scaly skin; (c) keep ocean swimmers warm; (d) have no effect on frostbite or freezing of the feet (in the Russian Army in World War II). Pay your money; take your choice. Animal or vegetable oils (lanolin, castor oil, etc.) are best for dry, cracking skin. Mineral grease (vaseline or axle grease) is better for keeping swimmers warm.

Soaps containing excess of alkali (most perfumed "complexion perfectors") or medications ("B.O. preventers") cause much dermatitis. The only soaps to be recommended are those safe for a baby, e.g., "Ivory" or "White Swan." Uncivilized Eskimos don't use soap, and they rarely bathe. When their skin gets too dry they may use a little animal fat.

Adhesive tape (sticking plaster without guaze pad) applied to tender spots on hands or feet BEFORE abrasion or blister may save a disabling infection. Put tape over metal objects which must be handled with bare hands in extreme cold.

Beards

Explorers traditionally grow beards. Shaving in cold water can be trying, and occasionally the necessary razor, soap, etc. are excess weight. One school says beards keep the skin warm, another says they cover the telltale signs of frostbite. The ends of the earth are the only place a man can get through the scrawny growing phase without some ridicule. Every man wants to grow a beard at least once, so most first-timers grow beards.

One school insists that a clean shave is good for morale. Whose morale? The important thing about beards is that they are a matter of individual taste and preference, and no one in a position of leadership or command should force his preference on his associates--one way or the other. This does destroy morale.

Fatigue

Fatigue predisposes to death in polar climes. Man in these regions should constantly be aware of it. Individuals vary widely in physical endurance; in mental elasticity; in past and present health and nutrition; in body type, race, age and past experience. Inseparable from physical fatigue is mental fatigue, caused by worry, fear, frustration, boredom and personality clashes from crowding in polar habitation.

Dangerously, fatigue causes haste, carelessness, and lack of appreciation of conditions predisposing to general hypothermia and/or freezing injuries. In a vicious circle, secondary apathy, headache, loss of appetite, and increased susceptibility to "colds" further irritability, and creates more fatigue.

In the cold the human "engine" runs faster and harder. Heavy, voluminous clothes make common physical exertions more difficult. There are no "little jobs" at temperatures less than -30°F. An ordinary four-man half-day job becomes an eight-man all-day job.

Experienced leadership, expert planning of tasks to be accomplished, and sensible control of exertions diminish fatigue. Clothing must be as light and comfortable as possible, yet maintain body warmth. Man must be regularly "refueled" with adequate palatable diet. Periods for mental relaxation and recreation should be planned. Above all, there must be adequate physical rest. This rest is best when the body has a warm, clean, comfortable bunk in a quiet, darkened, well-ventilated bunkroom. Cots and/or air mattresses, foot "pocket warmers" (when they work), and a clean, dry sleeping bag make the trail almost comfortable. Whether in permanent camp or on the trail, continuous fire or safety (carbon monoxide) patrol contributes not only to longevity, but also to the mental relaxation necessary for restful slumber.

Altitude Sickness

Men suddenly transported to the South Pole, to the Greenland Icecap, or to high mountain pass or peak for duty may suffer altitude sickness or mountain sickness. This will hit from 9,000-10,000 feet up. Over-exertion and fatigue in the unacclimatized brings on headache, nausea with vomiting, dizziness, weakness, and a wish to God you weren't there. Sleep may be restless and in short periods with bad dreams. The treatment is rest, take it easy, and give your red blood corpuscles a chance to build up in number in order to carry more oxygen to the tissues, particularly to the brain. You'll find cigarettes taste awful, give you indigestion and the "pitti-pats" (in case you were never conscious of your heart before). Leave them alone and you'll more quickly acclimatize to the altitude. It takes 2-3 weeks to usefully acclimatize, 6-8 weeks to completely acclimatize, and there's no known way to speed it up.

One last word on altitude: for man, one drink at 10,000 feet equals three drinks at sea level. If you don't want to be drunk at unaccustomed altitude, take it easy or LAY OFF ALTOGETHER.

Alcohol

Hot drinks not only contribute to overcoming physical fatigue, but if at regular hours they become something to look forward to. Hot toddies or a shot of good liquor on occasion not only give physical relaxation by promoting a comfortable sense of bodily warmth, and a cardiovascular relaxing peripheral dilation; but through relaxation of inhibitions, euphoria, and feeling of well-being, they promote mental relaxation, thus contribute to morale.

Beer is a logistic luxury. Freezing sometimes causes bottle breakage, sedimentation and loss of carbonation. It contains tannic acid which must be detoxified in the liver, and in cold weather the liver may be somewhat overworked chemically producing heat and handling a heavy diet. Oddly, beer is as delicious at the poles as it is in the tropics. Grain alcohol, vodka, and properly-aged hard liquors are less toxic and far more compact.

Because of close quarters in polar camps, the drunk is particularly obnoxious, and in this climate he is a liability to himself and to the group until sober.

Alcohol taken on the trail in subzero temperatures where bodily fatigue may be extreme with lethargy, apathy or slow mental reactions, may lower the body temperatures to the point where death occurs. However, oft-told tales by old explorers (rarely recorded in the official documents of their expeditions) disclose that many gallons of spirits have disappeared pleasurably on many occasions, albeit with some close calls and a few deaths. On the whole the good in controlled imbibition outweighs the bad, and it may contribute to a healthier, happier crew.

Tobacco

Tobacco is an unnecessary weight and expense. Those habituated become nuisances to themselves and others when the supply runs out.

There are three toxic dangers in the use of tobacco which are as follows:

2. Chewing tobacco or cigar butts gives the true effect of nicotine—a sympathetic nervous system stimulating alkaloid which causes constriction of arterioles and makes the user prone to cold weather injury. The irritants in tobacco have been accused of causing lip and mouth cancer (Gen. Ulysses S. Grant).

b. Smoking subjects the lips, mouth and respiratory tree to two toxins:

1. Carbon monoxide: This is what gives the "lift" to smoke and what makes one dizzy the first puff after long abstinence. This definitely affects "wind" and fatigability. Because it diminishes oxygen available to the tissues, use of tobacco is forbidden during treatment of patients suffering a frozen extremity.

2. Smoking is a steam distillation of the smoldering tobacco leaf and produces coal tar which, whether from smoking or from industrial "smog," undoubtedly is responsible for the increase in lung cancer reported by the medical profession the past 20 years.

Hygiene Do's and Don't's

1. Bathe generally no oftener than once every seven to ten days. Crotch, armpit and toe bathing may be indicated a little oftener for social acceptance, but

if clothing is worn correctly and housing temperatures are kept low enough, this will not be necessary. On the trail, men suffer no ill effects from not bathing for four to five months.

2. If bathing is impossible, clean your feet with the socks you've been wearing before putting on clean socks.

3. Keep busy, yet get sufficient rest; have tolerance and consideration for your messmates. Give liberally of your talents for the enlightenment of others and morale will stay high.

4. If you use alcohol or tobacco, be moderate in camp. Abstain on the trail.

5. Don't overdo physical exertion until you learn your cold weather limitations. If you have sensible perspiration, you have done too much too fast. If you do get wet from perspiration or otherwise, keep moving until you dry out or can get into shelter to take the wet clothes off. Don't chill!

PSYCHOLOGICAL ADJUSTMENT

In novices and in old explorers the first effect of increased suprarenal and thyroid activity in the first month or two of life in the cold is to make those people over-active, "nervous," quick to anger, and easy to offend. There is tendency for increased eating, drinking, smoking, recreation, etc. There seems to be a "times 2" factor in everything. Rapidity of thought with pressure of deadlines, frustration by weather or other circumstances cause quick tempers, irritability, and "spinning of wheels."

Fear or anxiety in a strange environment is most pronounced in newcomers without experience or as much training as the old hands who have learned faith in themselves and in the Almighty or they wouldn't return. As familiarity breeds contempt, the tyro group slowly begins to lose motivation, efficiency, and desire for work. During winter isolation they slow down mentally. Ambitious projects and pre-expedition plans are rarely completed, sometimes barely started.

With longer and longer nights until it is completely dark comes some depression to most, and to a few, self-pity. Those who expected to "rough it" are depressed by the comfort of most polar camps. Life for most men in these camps is dull and mundane, lacking any sense of adventure, and those lacking sense of humor and flexibility are disillusioned.

The art of self-entertainment with talk, writing, music, theatricals, games, art, and good reading has been largely lost through the rapid advance of television, radio, movies, nightclubs, and girlie shows by an entertainment-crazed society whose taste to those who love opera, symphony, and the legitimate stage is

deplorable. Those first to break down are the ones with few inner resources and little cultural or advanced education who, when they "find themselves" in an isolated polar community don't like what they see. The psychological low in most camps is just before midwinter.

"Big Eye"

This is a term used to cover a number of phenomena. Polar life in fixed camps for many is like war, days of boredom and inactivity interspersed with moments of terror. Some, through boredom, loneliness, or worry develop insomnia. This is assisted, no doubt, by frequent trips to the coffee urn late at night, until the "big eye clubs" formed of people with similar problems or interests often seem to drink coffee all night.

"Big eye" is also used to denote those with a "10-mile stare in a 10-foot room." This is found in those who do a great deal of reading, writing, or close work, at their jobs or on leisure time. Their fatigue of ocular accommodation is relieved by the stare. There is the neurotic day dreamer type who, in rebellion against his environment, stares into space frequently to lose himself in fancy of the future or in past pleasures. Lastly there are "normal neurotics" with an element of self hypnotism who stare sightlessly and thoughtlessly when they aren't sleepy, are well fed, comfortable, and can't think of anything pressing to do at the moment. "Big eye" is not a polar phenomenon. It may be found in the confined spaces of control towers, submarines, prisons, etc. Some are cured by the fitting of proper glasses, some are neurotic, some are normal. It is more often a phenomenon of the educated, for more primitive people faced with the same dearth of stimulus simply go to sleep.

Headache

Headaches are frequent in some polar camps. Some have ascribed them to tension from restraint or feelings of aggression arising from close quarters. This conclusion was drawn because figures at two bases one season showed that scientists and officers had three times the incidence that enlisted men did. However, it is our opinion that most headaches are not due to tension, but are due to:

1. Sinusitis sicca caused by cold outdoors, and by excessively dry and often too hot air indoors.
2. Dehydration from cold acclimatization (in a few), from excessive indulgence in coffee, and from excessive alcohol intake.
3. Inadequate ventilation causing toxic accumulations of carbon dioxide, carbon monoxide from heaters and cigarette smoke, and fumes from heaters, stoves and water melters.
4. Excessive smoking caused by boredom, and
5. Excessive eye strain from inadequate lighting, too much reading, close hand icraft work, excessive movies, and in winter rarely anything to look at over 50 feet away.

Group Attitudes

At the end of the winter when the group of old timers is replaced by a new group, the old timers are "beat" and sick of the place. The newcomers are bubbling with enthusiasm and energy. The old timers look on the new group as usurpers of something which has become a part of them, and they are suspicious of the new stewardship. After all, they've BEEN there, and the newcomers are hardly a cut above the summer "touristos." On the other hand the newcomers may be shocked at their first view of a polar camp and wonder why the old timers didn't make better use of their time. Group loyalties are high, and as soon as continuity can be assured, the old timers should be sent back.

In smaller groups, and with a cadre of stable oldtimers who can take two years running, the British F.I.D.S. expeditions maintain a nicer continuity of operations, although it is suspected that occasionally "old school" clannishness may raise its haughty head.

In small parties, two men, because of their interdependence, will get on well together, and will tend to overlook each other's irritating habits or mannerisms. A party of 3, unless one man is experienced and is the acknowledge leader, will end up with two men picking on the third for some quirk, and there is almost bound to be trouble, unless all three are Scotchmen, in which case they will form a St. Andrew's Society and harmony will reign. Parties of four will usually get on, because they will pair off and balance their banter.

Readjustment

Having withstood adjustment to a polar environment with minor personality changes for a year or so, what happens when a man comes back to civilization? Depending on the original personality, polar life can be a forge for tempering steel or an oxidant for rusting it. Longer stays on the ice tend to give more profound and more fixed changes. The readjustments are easier and take a shorter time each time a man returns from a sojourn in country as strange as the moon.

One learns to truly appreciate good cooking, a drawer full of clean, mended clothes, the beauty of trees and flowers, the smell of new-mown hay, the sound of a mocking bird or meadowlark.

Why do some men return again and again to these regions? As in the burial ceremony for the late lamented, we forget his faults and praise his good. Man fortunately remembers the fun and forgets the hardships of the expedition. Some return because they originally found themselves there, some because they are more appreciated on the ice than in civilization, some for unsatisfied ambition, some to continue a fascinating investigation, and some because they hear Aurora's song in a polar sunset.

Morale

To combat monotony, boredom, frustration, mental fatigue, depression and self-pity, which sometimes occur in isolated polar camps, particularly during the long dark winter, the following suggestions are offered:

1. WORK. All hands should realize that they may have to CHEERFULLY and efficiently take their turns in rotation at common camp duties, building, shoveling snow, carrying snow, digging pits, cleaning common spaces (every man is expected to keep his own quarters clean and free of fire hazards), serving, doing dishes, cooking, etc. This may be drudgery, but it changes routine and contributes to the health and happiness of all, particularly to the man involved. If a man's work is well-planned, he will look forward to the next day's tasks. The man who enjoys his work and has plenty to do is least likely to deteriorate and develop "cabin fever" or "blackout blues." Obviously useless or invented work has the opposite effect.

2. FOOD. It is desirable that a wide variety of food be available. It should be tastily cooked in as many varying ways as possible, pleasantly served and in adequate amount. On small bases differing individuals may take turns planning the week's menu. Men who cook specialty dishes should be encouraged to spell or help the regular cook, who should be free of regular cooking duties one day each week. At small bases, seating arrangements should be varied from time to time.

3. REST. There should be no noise after 2200 and no lights after 2400. Sleeping rooms should be at +50°F. and well-ventilated. Daily physical exercise with weights, ping pong, even hopscotch, will assure those with sedentary jobs sufficient fatigue to assure sleep.

4. PARTIES. Once every five to ten days in wintering camps, on national holidays, Midwinter's Day, Christmas, Easter, birthdays of individuals, and on Guy Fawkes' Day, a community party with movie, home talent acts, special food, and social liquor is a great morale booster.

5. EVENING ENTERTAINMENT. Movies two to three times per week. Lectures one or two times per week on sciences, exploration, travels, physiology, first aid, safety, survival, etc. by competent authority impart valuable information. Toastmasters Clubs teaching public speaking, correspondence courses, and courses in foreign languages are profitably-spent time for groups.

6. GROUP PROJECTS. Small groups may want to train in choral singing, play in musical groups, build a Finnish steam bath, compete with other groups at games or contests.

7. TOURNAMENTS, to establish camp championships at dominoes, chess, checkers, card games, backgammon, etc., create interest. (Gambling for money

is usually to be frowned upon. Few friends are made gambling, and a small camp can't tolerate enmities well).

8. CREATIVE HOBBIES. Painting, woodworking, photography, leatherwork, model-making and scrimshaw make many forget their troubles.

9. LIBRARY should contain a wide assortment of books on biography, history, travel, novels, etc., depending on the educational level of the crew.

10. MUSIC has charms, but there should be enough separate record players far enough apart that the lovers of symphony and jazz won't get in each other's hair—they may anyway.

11. NEW from the outside world by circular or bulletin and use of amateur "ham" radio for contact with families can both help and depress morale, for good news may be counteracted by news of death, illness, divorce, broken engagements, etc., which in isolation produce magnified worry, anxiety and grief.

12. INFORMATION by bulletin board or camp meeting helps morale. News of personal interest, job rotations, projects, etc. lets each man know how he fits hour by hour, day by day, and month by month.

13. PRIVACY for individuals, particularly in smaller camps is almost a necessity. There are times when the face of one's best friend is almost intolerable, and man to maintain his balance must have time and a place where he can face only himself.

"Big I"

Three types of men go to the polar regions: egocentrics, egomaniacs, and "Ego" Scouts. Whatever the personality, most men have egocentric motives in volunteering for polar duty. The publicity and acclaim given most expeditions in the past have turned the heads of some leaders, making them selfish, arrogant, dictatorial, omnipotent, jealous of others, and sometimes frankly paranoidal. In the past, leaders of expeditions have got on together about as well as lead dogs of rival teams.

Some egocentric expedition members have felt that they were being held back and did not get their share of the acclaim. In their drive to "be somebody" some have become expedition leaders and have quickly fallen into the above egomaniacal pattern. The leader with strong feelings of inferiority, making him overly ambitious, may be early ostracized by all hands or will find mutiny in his camp before season's end.

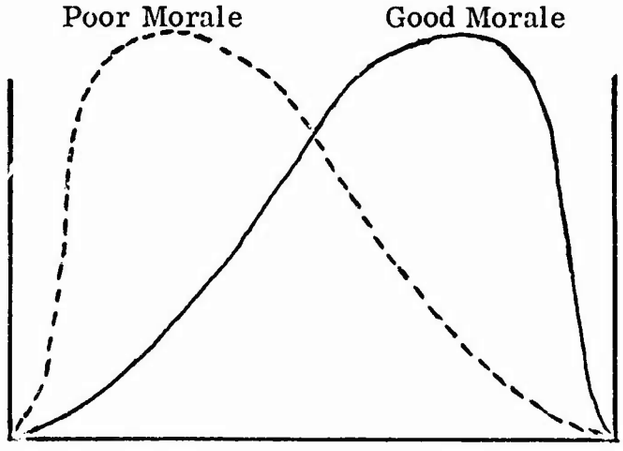
Ego (Eagle) Scouts at an early age have ambition. Their advancement gives them close acquaintance with nature, and with their responsibility to other individ-

uals and to society. It teaches many skills invaluable to life on the frontier. They early realize that with advancement and "being somebody" must eome responsibility and l amility. With maturity they make exeellent leaders. If not inelined to lead, they're handy on an expedition.

Leadership

As in a military campaign, leadership of an expedition will play a large part in the happy and efficient accomplishment of its mission. Leaders must be strictly selected from well-qualified volunteers, and should be elosely studied during performance of predeparture duties. Responsibility and authority erystallize charaeter, either uneovering hidden talents and bringing out the best that is in a man, or turning him into an intolerant, bigoted dietator who will be ostracized by all hands or who will divide a group into warring faetions. This is particularly true in polar regions where close assoeiation peels baek the veneer of sophistieated soeiety, where weaknesses in personality beeome grossly magnified, where eseape from the group or individual is impossible, and where increased adrenal aetivity causes gross flaming of smoldering emotions.

Well-balaneed individuals from day to day probably balance a little to the right of eenter on the following ehart (or we like to assume they do).



PREJUDICED
Selfish
Irresponsible
Sad
Lazy
Lonesome
Quiet
Fearful
Cowardly
Daredevil
Rude
Uneooperative
Ineffieient
Thoughtless, Vain, Braggart
Weak, Still, Fatigues
Apathetie, Unimaginative
Seditious, Dirty

TOLERANT
Generous
Trustworthy
Happy
Industrious
Center of attraction
Communieative
Confident
Brave
Prudent
Polite
Cooperative
Efficient
Considerate, Humble, Modest
Strong, Active, Energetie
Self-reliant, Organized
Loyal, Clean

As these eharaeteristics are found in the individual, so there is a distribution curve in the group. The total and day to day balance of these faetors in the leader or leaders will shape the pattern, degree and distribution of morale and efficieney of the entire group by example and preeept. Leaders must be practieal students of men and their behavior. A leader's most valuable asset is an introspeetive ability to dissociate himself from time to time, mentally sit on a eloud, look down on

himself as a member of the group, and unemotionally evaluate not only his own mental "inventory" and behavior, but coldbloodedly assess its effect for better or for worse on the group. If the leader is never quite satisfied with what he sees from the cloud, if he determinedly works to better the picture, and if he can maintain his sense of humor, the expedition will be a "ShackeltoNansen" classic.

Leadership demands (1) intelligence and understanding; (2) good example; (3) firm justice; (4) loyalty up, but more important, loyalty down; (5) sense of humor; and (6) sufficient respect for the ego of others to praise in public but always criticize strictly in private.

John Paul Jones' immortal leadership recipe nicely utilizes these ingredients:

"It is by no means enough that an officer of the Navy should be a capable mariner. He must be that, of course, but also a great deal more. He should be, as well, a gentleman of liberal education and refined manners, punctilious courtesy and the nicest sense of personal honor.

"The Naval Officer aboard ship and in relation to those under his command should be the soul of tact, patience, justice, firmness and charity. No meritorious act of a subordinate should escape his attention or be left to pass without its reward, even if the reward be only one word of approval. Conversely, he should not be blind to a single fault in any subordinate, though at the same time, he should be quick and unfailing to distinguish error from malice, thoughtlessness from incompetency and well-meant shortcoming from heedless or stupid blunder."

HEAT CONSERVATION

Newton's law of cooling states that the rate of cooling of a body hotter than its surroundings is proportional to its surface area and to the difference in temperature between the body and its surroundings.

Body heat loss in resting man is about 55% through radiation, 15% through convection and conduction, 23-27% in insensible evaporation from the lungs and skin, and 2-9% from the warming of inspired air. As external temperature decreases and heat loss increases, proportionately less of the heat loss is from radiation, and more is from convection, conduction and evaporation.

Muscular exercise even in extreme cold causes sweating. Apprehension and frustration cause "cold sweat," most dangerous to hands, feet and forehead. Because moist surfaces conduct heat twenty times faster than dry surfaces, and because water is fourteen times more cooling than dry air, in the cold, man should keep his clothing dry and should underdress almost to the point of discomfort to prevent sweating with resultant rapid heat loss by evaporation and conduction.

In order to have physical measurements with which to compare differing clothing, researches developed the "clo" unit, which is defined as:

$$.18 \frac{^{o}C.}{\text{kcal/sq. m/hr}} \text{ or } .88 \frac{^{o}F.}{\text{B.T.U./hr/sq. ft.}}$$

Visualized this means the thermal insulation which will keep a sitting, resting man of metabolism 50 KCAL/sq. m/hr comfortable indefinitely at temperature of 70°F. (21°C.), relative humidity less than 50% and air movement 20 ft/min (1/5 mph). This is of theoretical interest in the laboratory but of little value in the field.

Practically, however, using this formula's variables, we may assume (1) a group of resting men have about the same energy expenditure; (2) relative humidity is insignificant; and (3) temperature and wind have a great bearing on the amount of insulation necessary, and of the two wind is more important because by far, the greatest heat loss is by convection.

"Wind Chill" tables, giving correlation between temperature and wind, have been prepared for naked man, using physical and not physiological test subjects, and spherical diameters foreign to man. Man's cooling varies with body diameters, air turbulence, type and amount of insulation, activity, and positional relation to the wind. Use of tables below -20°F is impractical, because the wind chill factor is off the chart. These tables have use in cold indoctrination of masses of inexperienced soldiers by uninitiated officers.

Wind is of increasing importance from 0-10 mph, but of decreasing importance as the velocity becomes higher. Hence, in polar climes the most important single item of general clothing is the outside layer which repels wind, yet which should allow the escape of vapor to prevent a moist skin. Total vapor barriers are grossly dangerous.

In spite of the physiological methods of heat conservation (vasoconstriction, dehydration, slowing and shunting of blood circulation, and deposition of fat), man must clothe to survive cold climates.

CLOTHING

Clothing for man in the cold must be, in order of importance, protective, comfortable (light, loose, simple), durable, and easy to clean. It may also be "stylish," but NOT at the expense of any of the above factors.

Because of the author's personal discomfort and dissatisfaction with the efficiency, weight and bulk of issued military and privately acquired clothing, he

began clothing research in Antarctica in 1956. Observation of previous U.S. Antarctic clothing, of British Himalayan and other clothing worn by New Zealanders, of privately-owned items of American explorers previously in the Arctic, and based on Eskimo principles (so far as he knew them), he began, with his wife's assistance, to manufacture clothing for field trial and modification on subsequent expeditions.

The Eskimo has been in the business of cold survival quite successfully for a long time. His 1-1/2 to 3"-thick caribou or bear skin clothing gives 7-12 clo units of insulation, but less than 4 clo units are used when the Eskimo is active at temperatures of -40°F. He doesn't remove his clothing--he utilizes the "diving bell" principle of pullover parka enclosing warm air. To cool off, he ventilates the bell at neck and skirt. In skin tents, rock, earth or wood buildings, he maintains temperatures about 70°F. in daytime and 50°F. at night. In bad weather he stays inside. He is out an average of 2-4 hours per day in winter and 5-9 hours per day in summer. When exercising, he maintains a steady moderate pace to keep warm without over-exertion. Ordinarily he wears only one set of garments, usually fur out. In extreme cold he wears the less durable skins of smaller animals sewn together in fur inner garments. This gives him three dead air spaces with two garments.

For large numbers of men, furs are not available, are prohibitively expensive, bulky, hard to clean, and there are not enough people who know how to construct and maintain fur clothing efficiently. (This is the prime reason why early explorers took Eskimo women along on long excursions or hunting parties.)

A vacuum is ideal heat insulation; next best is a dead-air space, of optimum efficiency 1/2" thick. To keep air "dead," minimally conductive fur, fleece, plastic, or compartmentation minimizes convective air currents. This insulation should be non-hydroscopic. The ideal outer shell would be pliable, light, durable, wind-resistant and waterproof, yet allow water vapor from the skin to escape. A series of these insulated clothing shells will allow man to accommodate himself comfortably to the complete range of polar temperatures, with and without exertion, by donning or doffing one or more layers.

Textiles

1. Avoid nylon-fiberglas combinations. They are said to be almost explosive and burn like magnesium.

2. Cotton. The best is Egyyptian cotton with the longest fiber. "Sea Island" or "Pima" is the longest-fibered American cotton.

(a) Weaves. Broadcloth (poplin or sailcloth) with square weave in general is more air-tight than twill (gabardine) or sateen weaves.

(1) The original (1928) Byrd cloth was broadcloth 120 x 132 cotton

threads to the inch. It was an excellent windbreak but was rather liable to tearing. This was patented by Reeves Brothers, Worth Street, Philadelphia. Since that time, many textiles have been called "Byrd" cloth. The windproofs of Operation DEEP FREEZE have been cotton "Byrd" cloth of gabardine weave from 94x144, 56x96, 59 64x80. They have been only moderately efficient and quite friable.

(2) The same thing probably happened to "Grenfell" cloth, for the fabric I used as lining on my first homemade parka (proving to be unnecessary weight) was a 56x66 cotton twill which was not as windproof as my service summer khaki dacron-pina cotton shirt.

(3) The shell of my first parka was Egyptian sailcloth (British "Ventile"), 96x108 threads/inch, which shrunk remarkably to 104x120. This was an excellent windproof, but in cotton at 4 oz/yard, it proved too easily torn and to have little abrasion resistance.

(4) My second parka was made of "K_2 cloth," a 5 oz/yard cotton broadcloth of 72x112 count before washing. This was more durable but still not satisfactory.

(5) "Brinje" cotton fishnet insulation has been worn inside wind-resistant outer shells, but its weight is relatively too great for other than underwear.

(b) Advantages of Cotton
(1) After first washing there is little shrinkage.
(2) No static in blowing snow.
(3) Clothing easily mended.
(4) No foreign body reaction in puncture wound.
(5) Non-irritable to skin (if undyed).

(c) Disadvantages of Cotton
(1) Quite heavy if wear- and tear-resistant.
(2) Flames in fire.
(3) Dries slowly.
(4) Inelastic.) As fluff
(5) Mats with wear.) insulator

(d) Uses in Polar Clothing. Underwear and innermost socks (grieg, undyed, or white)

3. Synthetic Fibers
(a) Fabrics

(1) Because of their abrasion and tear resistance with relatively light weight, nylon has been used a great deal in military and alpine cold weather clothing in wind-resistant and windproof fabrics. "Wyncol" is the light Everest windbreaker cloth made by Howard Flint & Co., Avery House, London. "Duplon 2060" - 2 oz/44" yd. (tears too easily), and "Duplon 2131" - 4 oz/44" yd. (quite tear-resistant) are neoprene-coated nylon fabrics which are said to be waterproof,

yet allow vapor from inside clothing to escape. It is made by Duplon of Canada, Ltd., 423 Mayor Street, Montreal 2, Quebec. Heretofore use of rubber, latex, or neoprene for clothing or clothing fabrics has retained insensible perspiration and sweat to the extent that the insulative property of the clothing was lost.

(2) One-ounce rip-stop nylon parachute fabric (104x104 with a heavy line every 20 fibers) is delightfully strong for its weight. It makes slick liners for heavy clothing, making them easier to don and doff, although it is extra weight. It has been used as shell for quilted underwear in some of the finest sweat-producing clothing to date. I use it only for the inner pocket of parkas.

(3) Relative lightness and elasticity of nylon is responsible for some of the best fluffy insulation fabrics.

a. Possibly the best of these insulators (I haven't used it) is "Flalon," a nylon fleece with nap on both sides, giving it theoretically the greatest resistance to compression per unit weight. This is 10-1/2 oz/42" yd. and is made by Kitchener, Ontario, Canada.

b. "Ephernyl" nylon fleece, 11' oz/yd. is made by Official Fabrics, Inc., Div. of Hanora Fabrics, 1412 Broadway, New York 18, New York. It is the fleece used to line my parkas and pants, and for the added layer in the elbow, knee and butt of all shells, shirts and trousers.

c. "Carmolon" at 14 ox/yd. is a short orlon pile woven in a cotton back by David B. Carroll and Co., 205 W. 39th, New York, New York. It should be washed before tailoring. This is not quite so desirable as "Ephernyl" because of weight, nor as "Baronessa" because of its short pile.

d. "Baronessa" is a 3/8" wool pile on a nylon back, 19 oz/yd., made by The Shelton Looms, Sidney Blumenthal Co., 1 Park Avenue, New York, New York. It doesn't shrink perceptibly when washed.

(b) Advantages of synthetics
- (1) Sheds water.
- (2) Strong to abrasion and tearing
- (3) Elastic.
- (4) No foreign body reaction in puncture wound.
- (5) No shrinkage.

(c) Disadvantages of synthetics
- (1) Melts in flame.
- (2) Very hard to mend.
- (3) Brittle in extreme cold.
- (4) Produces static in blowing snow, and in contact with wool.
- (5) "Cold" fabric.

4. Cotton - Nylon

(a) Fabric. Mil-C-3924, cotton warp and nylon filling, oxford, military specification of 9 August 1954, amended 16 April 1957, is a tough, extremely

wind-resistant 5 oz/yd. fabric, 196 warp x 68 filling, which I have used for all pants, shirts and parka shells since 1959. It was developed for the U.S. Department of Defense. I don't know if it has ever been produced for commercial use.

(b) Advantages

(1) Very little shrinkage (1 to 2%).
(2) Chars to flame. Isolated holes have tough edges.
(3) Excellent tear and abrasion resistance.
(4) Mends beautifully.
(5) Sheds water.
(6) Washes easily, drip-dries without wrinkles.
(7) No foreign body reaction to puncture wound.
(8) No static in blowing snow.
(9) Non-irritating to skin.

(c) Disadvantages

(1) Isn't on the open market.

(d) To compare Mil-C-3924 with two similar cotton fabrics, Mil-C-342B of 17 October 1956, Cloth, Cotton, Twill and Poplin, Wind Resistant, the following figures speak for themselves:

	Mil-C-342B Cotton		Mil-C-3924 Cotton-Nylon
	Twill	Poplin	Oxford
Weight, oz/yd.	5.0-7.0	5.0-7.0	4.5-5.5
Yarns/inch	185x90	106x52	196x68
Breaking Strength	175x75	125x65	185x140
Minimum water repellency after washing measured as hydrostatic pressure	21 cm.	21 cm.	30 cm.
Maximum dynamic absorption	35%	35%	30%
Air permeability cuft/min/sqft	8.0	5.0	3.0

5. Wool

(a) Fabrics. As the cheapest, most commonly used animal fiber in clothing. Wool fabrics are myriad in variety, weight and fashion. Its greatest use in polar clothing is in keeping feet dry and insulated.

(b) Advantages

(1) Hygroscopic.
(2) Elastic.
(3) Slow to burn.
(4) "Warm".

(c) Disadvantages

(1) Hygroscopic.
(2) Irritates skin.
(3) Shrinks a little more each time it is washed or cleaned.
(4) Heavy when woven tight and thick enough to impede air movement, or to have good abrasion resistance.
(5) Produces static in blowing snow, particularly when in contact with plastic fabrics.
(6) Foreign body reaction with puncture wound.
(7) Hard to mend.
(8) Moths love it.

(d) Uses. Irreplaceable in

(1) Second (or third) layer of well-shaped socks (if not washed too often).
(2) As sheepskin for the hygroscopic bootee in the mukluk. This inner bootee, with adequate replacements when it gets wet, answers the requisites for foot gear that the skin temperature must be maintained at 68° to 94°F. for comfort.

Inner Clothing Layers

Clothing layers providing 1/2" thick dead-air space give maximum warmth/weight. Thicker garments lose efficiency due to heat loss by internal convection currents.

a. Underwear. Insulation for the innermost dead-air space comes from underwear. Brinje, fishnet or raschel cotton underwear, woven 1/8" to 3/16" thick, four holes to the square inch is thicker, more efficient and only half as heavy when wet (and much easier to dry) than conventional cotton long underwear. It neither shrinks on washing nor irritates the skin, as do wool or part-wool garments. Easily washed summer underwear shorts are worn under it to keep it clean inside longer. ("T" shirts may be worn under Brinje undershirt if heavy back pack makes the fishnet uncomfortable; likewise, undershorts reduce irritation of the tender sessile explorer to "waffle butt" engendered by excessive sitting.)

Second best underwear is cotton waffle-weave developed by the Navy on the brinje principle, but the holes were filled to reduce arguments with skeptics. Not as thick as the above fishnet, it is not as efficient.

Avoid quilted nylon underwear, for it causes excessive sweating with exertion.

b. Shirt. Wind-resistant shirt and pants over underwear maintain the innermost dead air space. The "All-American Boy" wears wool plaid shirts to keep warm--besides, they're colorful and make him look like a pioneer. Wind goes through, and such a combination is actually quite cooling in hot windy weather. Wool service shirts are tighter in weave and heavier, but the wind goes through them too. The standard tightly-woven summer service shirt, part cotton and part nylon or dacron, "wash and wear," theoretically a cool shirt, because of its wind resistance is a very warm winter shirt when worn over thick underwear, except that wind blows in the front between the buttons. My cotton-nylon pullover shirt is made with collar and button flap pockets to the measurements of a uniform shirt. The "cowboy" neck allows easy donning, minimizes air ventilation, and allows effective neck closure with only one button. The aloha shirt skirt can be worn in or out of trousers to allow ventilation, for the "bell" principle assures maximal efficiency with minimal weight and maintenance. Those who object to pullover garments are lazy, arthritic, or too old to be engaged in cold weather operations. Length of the shirt allows the bottom seam to hang at mid-pelvis with the shirt out. Button-tab sleeve closures allow open sleeve aperture for ventilation, or closure on the second button to minimize air circulation without constricting blood circulation to the hands.

c. Pants. These are tailored full-butt to allow room for complete non-compressing flexion of the thighs, to minimize heat loss when seated. Like pajamas, they are held up by a parachute riser nylon tie-tie, which minimizes the area of heat loss (quite remarkable on infra-red studies, from the constriction of even a narrow belt). One feels insecure, but gets used to the lack of security of the pajama top." Bottoms are equipped with heel straps worn over outer socks and fine cord bottom tie-ties. Pockets, two front and two back, are external patch pockets with nylon "Velero" or button pocket flap closures. With mukluks, this outfit is comfortable indoors without sweating up to 80°F. (too hot). Under windless conditions out-of-doors, with added gloves or mittens and chaperone (cap), it is comfortable down to 30° to 50°F. sedentary, and down to -20° to -30°F. with exercise.

Second Layer

a. Inner Parka. Only a wind-resistant pullover parka with hood made to Eskimo pattern, lined head and front pocket with "fur" pile on shrink-proof base, trunk and arms lined with nylon fleece, increases tolerance to cold down to 10°F. sedentary and down to -10°F. with exercise. Loosening tie-ties at face, neck, belt, crotch and button flap sleeve allows aeration and cooling.

Sleeves should be sufficiently wide at the shoulder that the arm and hand may be pulled up inside the sleeve and the hand put in the opposite armpit to thaw

frostbite with minimal loss of core temperature. This width also minimizes pressure on the brachial artery, which in "conventional" coats predisposes to cold injuries of the hand.

b. Pants. This wind-resistant shell, lined with nylon fleece, with above parka gives comfort down to -30°F. sedentary and to -60°F. with moderate exercise. They are held up with figure "8" G.I. suspenders, have pyjama top tie-tie and small bottom tie-ties to keep out snow. Belt circumference should be four inches larger than inside pants to allow retrieving articles in inside pants pockets with belt tie-tie loosened. Cargo pockets at thigh sides with bottom flaps above parka border give ready access to treasures with minimum of heat loss or snow in pockets.

Trunk Protectors of "Core Heat"

Traditional wool sweaters are too heavy for the warmth provided and they are wool. Cotton sweaters are heavier. A light quilted dacron vest covering thorax, kidneys, and upper belly, worn between shirt and parka, is the difference between cold hands and feet with much shivering at -50°F. and absolute comfort at -60°F. sedentary. These are to be found in Army-Navy surplus stores. (As manufactured, they're one inch to three inches too short for tall men.)

Third Layer

The outer parka and parka pants are exactly like the inner items, except they are one inch longer and two inches bigger around. There need be no fur ruff on the outer parka hood tunnel. Since completing this outfit, I have not been colder than -60°F.; however, I believe the third layer, over first, second, and dacron vest, will take me in comfort down to -80°F. sedentary, and with moderate exercise to the world's coldest, -127°F., at least for a few hours.

Head

For usual mid-summer weather in Antarctica, the blue stocking watch cap or any other cap or hat with some ear protection under windproof parka is sufficient for most temperatures. For colder coastal conditions and for all inland or survival conditions a pile-lined windproof (not woven wool) balaclava is a MUST. Pile-in, pile-out windproof balaclavas and fur hats give maximum comfort at temperatures below -40°F., but produce massive sweating with exertion.

Heat loss by the unprotected head may be 1/3 of total body heat production at 60°F., 1/2 at 40°F., and 3/4 at 5°F. A wise Canadian observed, "A cold brain is a numb brain; only dumbrains get numbrains."

A "chaperone" is a wind-resistant pile-lined balaclava with a six-inch apron

fore and aft. It is excellent protection when using a sleeping bag and is indispensable for stretcher cases in casualty bags. Parachute jumpers swear by this item, and its the thing to be wearing if you're dunked in sea water. Heavy exertion in this headgear even at these low temperatures almost invariably causes sweating, so when exerting, the apron and bottom are turned up to give the appearance of a Museovite.

A thick, soft, woolen muffler gives great comfort to the neck and front of the chest under very cold conditions. It can also be used shawl fashion over the head should occasion demand. Wrapped twice around the face to breathe through gives fair protection to the lungs at temperatures below -25°to -30°F., particularly with heavy exertion, and at higher altitudes.

Sewing Notes

If you are going to make your own clothing or have a friend in the parachute loft:

1. Quilting using feathers, cotton wool, wool, or other insulating sandwich material gives light warm clothing; however, it is bulky; it is hard to clean and virtually impossible to wash and/or dry; it is rarely durable; it is usually very expensive if good; it mats or compresses with use; and the sewing union of inside to outside gives considerable conduction heat loss unless these lines are overlapped (more material - additional weight.

2. All materials should have a hot soapy wash, rinse and ironing before tailoring, for they will shrink more or less on first washing, and its better to err towards a little too large rather than the slightest bit too small in polar clothing.

3. All seams MUST be double sewed. Selvage for adequate seams must be at least 3/4" wide. Trim inner flap to 1/4" before folding over for second sewing to conserve weight.

4. Next to the skin all underclothing and socks should be white or undyed, to prevent any atopic skin reaction. Internal shirt and trousers may be of khaki, green or dark blue, depending upon service or fashion. For peacetime work, when visibility is often of paramount importance in safety and survival, "fire-house" or "chinese" red are the most visible colors when on the ice, in trees, or on black or brown earth.

5. If fur ruff is removed from the parka hood tunnel, the whole outfit (except for wool socks, shearling bootees and leather mittens and gloves) may be boiled if you desire.

6. Above all, DON'T start experimenting with zippers, tight sleeves, belts, additional wool, stockinette or elastic cuffs, vapor barrier fabrics, etc. These

are inefficient or actually dangerous: they violate the "bell" principle, add useless weight, complicate maintenance problems, and have already cost millions of dollars and years of fruitless labor. This clothing has been proven in the field and by infra-red photography. Recorded temperature tolerances eannot be expected with substitution for any of the items, e.g., substitution of plaid or service wool shirt for the light windresistant pullover shirt.

Hands

There is no one good method of maintaining fine manual dexterity for any length of time in polar regions. The gradient of temperature down the length of a limb from an adequate core temperature is more important in the eontrol of heat loss than is the gradient from deep tissues to the skin. E.g., keep the upper arm warm and the forearm will be warm. This gives the nod to the glove with only exposed tips of index finger and thumb for greatest comfort and longest dexterity where fine tactile sense is necessary.

a. Nylon gloves prolong exposure time somewhat, but interfere with skin sensitivity. Silk gloves are reported to be warmer than nylon, but hard to obtain.

b. Pigskin driving gloves give excellent general serviee during summer seasons on coastal stations. They must be removed for fine eamera adjustments, etc.

e. Thin leather gloves (at temperatures above -20°F.) or thin shearling or fur-lined gloves with tips of thumb and index finger slit or removed to allow minimal exposure of bare skin tips are the best eontaet gloves for fine work at lower temperatures.

Gloves, a, b, and c above utilized with windproof pile-lined "muff"-front parka pocket or with survival mittens, utilizing platinum-wick poeket warmers inside, enable photographers, mechanies and other workers to use bare or thinly gloved hands between periods of warming. Depending on temperature and wind velocity, a greater or lesser time of warming is neeessary.

d. Heavier leather gloves, fur-lined, or with inner wool glove, are exeellent for those requiring use of hands with functioning fingers.

e. Large fur in and/or fur out gauntlet survival mittens, with leather palms big enough to loosely cover a gloved hand and a small petrol poeket warmer, are a MUST. They are attaehed together and to the man by harness to prevent loss. The Army horsehide palm, pile-backed, nylon fleece-lined survival mitten is excellent with two modifications to deerease weight: (a) take one inch to two inehes off the high cuff, and (b) replaee eotton belt harness with nylon paraehute riser cord harness.

Feet

a. Socks. (From skin out)

(1) White medium-weight cotton undersocks - wash daily.

(2) Thick long wool ski socks - with foot proportionate in width and length, hence non-constrictive.

NOTE: (a) DO NOT wear cushion-sole wool or cotton socks if your feet are larger than size 10, for the larger sizes constrict foot circulation; (b) "Stretch socks" which are constrictive on feet should NEVER be worn; (c) Wash wool socks as infrequently as esthetically possible. They shrink increasingly with every washing.

b. Boots. No universally satisfactory boot has been developed for all cold weather. The following boots and combinations have limitations and certain requirements for successful wear. None have sufficient traction on ice or hard snow for complete safety or for truly comfortable walking.

(1) Thermal Boots. This double rubber insulated "vapor barrier" boot keeps the feet warm at temperatures down to -80°F., providing the wearer moves about. It is worn with one pair of cushion-sole wool socks. For shipboard four-hour watches it is ideal. For sloshing through mud or slush in near-zero temperature, it is a MUST. For the dry cold of the Antarctic, the full rubber length which does not allow the loss of any moisture from the foot makes it necessary to change socks, dry the feet, and dust the foot every two to four hours if painfully hot feet, hyperhidrosis, maceration, and ultimately trench foot (a condition more disabling than frostbite) is to be avoided. Men with jobs requiring alternate periods of activity and inactivity, e.g., those on tractor trains, may freeze their feet if they wear these boots. Some models crack and break at temperatures below -60°F.

(2) Ski Boots. Insulated ski boots worn with one cotton and one or two pairs of wool socks are warm enough for summer use on the Antarctic periphery where rocks and lava cut more friable soles. If they fit tight enough for comfortable skiing, they are too tight for safety from frostbite or freezing injury.

(3) Shoe-Pacs. With rubber bottoms and leather tops worn with felt innersole and at least two pairs of wool socks, they are comfortable for summer on the Antarctic periphery, but they offer poor traction on ice or wind-packed snow.

(4) Felt Boot. The white felt boot is worn with two to three pairs of socks and felt innersole. Providing it is kept free of snow with frequent brushing to prevent the boot getting wet, it is excellent footwear for the Antarctic summer. They wear out quickly and have very poor traction on ice or hard snow.

(5) Overshoe-Shoe Combination. This is contraindicated under almost all

circumstances because it is cold except under warmest summer conditions. It is a very heavy combination, and the wearer must stay in constant motion to maintain any comfort.

(6) Fur Mukluk. Give greatest comfort in polar midwinter temperatures. These are worn with a layer of dry grass insulation in the bottom. This grass (Senna) must be changed when it becomes frostladen. They have poor traction and are not waterproof.

(7) Canvas Mukluk. These are to be found in several colors, with zippers and with laces, with and without rubber pac soles. It is worn with one to two pairs of wool socks and one or more innersoles of felt, plastic mesh, or senna grass.

(8) Aviator Shearling Winter Flying Boot. This zippered shearling-lined boot has a rubber pac bottom. It may be worn over shoes, but only in camp or aboard ship, or for short trips between ice camps and ships. This is an aviation supply item of World War II vintage. It should never be worn over boots or shoes on long flights, for under survival conditions this combination makes the feet liable to freezing due to inelasticity and lack of insulation in the laced inner shoe. Both Air Force and Navy boots of this type have strong points and shortcomings - the designs should be combined.

(9) From 1956 to 1959 in Antarctica, the author wore the above Navy shearling-lined boot as a mukluk with one cotton and four progressively larger wool socks. The boots were continuously wet inside, even alternating use of two pairs of boots. In 1959, when experimenting with innersoles, he conceived and made a shearling bootee to Plains Sioux moccasin design, wool side inside, to take the place of the outer three pairs of wool socks. The boots became ideal mukluks, for they keep the foot WARM and DRY from +75°F. down to -60°F., sedentary or with exercise, when worn continuously for test periods up to 40 hours. All sweat accumulates in the inner bootee, which quickly dries overnight or in an inner thin "Kangaroo" pocket inside the inner parka.

With modification of outer boot, this double shearling principle has been acclaimed by over 90% of U.S. civilian scientists in Antarctica since DEEP FREEZE 1961. It is a practical utilization of an old Eskimo principle, which meets the requirements of 68°-94°F. skin temperature, dry foot and minimal constriction of circulation. A research foundation suggested, as drying modifications of rubber vapor-barrier boots: (a) dessicant liners*; (b) leather-rubber combinations*; (c) air pumps*; (d) insert insulation*; (e) conductive liner; and or (f) gas cooling. This mukluk fulfills four* of the above.

Sleeping Bags

The Army sleeping bag which opens down the middle of the top may be

satisfactory if you sleep flat on your back all night without moving. In case one moves during sleep (and most people do) a bag which opens across the top and down the side is more satisfactory, unless one wishes to sleep in parka or balaclava to keep the head warm. Sleeping bags should be big enough to make adjustments in position of rest without rolling off the pallette or air mattress. A good Aretic sleeping bag should assure six hours steady sleep at -65°F. under negative wind conditions. Rules for comfort include: (1) Breathe outside the bag to keep frost out; (2) Do not sleep in a bag with a waterproof cover, for frost will add about one pound per day to the bag weight; (3) Sleep bare or in dry underwear or "sweat suit," wearing one pair wool socks only; (4) Sleeping bags should be insulated from ground or snow (an air mattress or lilo is the best insulation and gives most comfort, but should be inflated by pump rather than breath to prevent internal icing); (5) A 1/2" Raidoprene or Ensolite (Polyvinyl Chloride Foam) blanket next to the sleeping bag absorbs moisture and prevents freezing of bag to air mattress or ground insulator; (6) Bags should be turned inside out and exposed to the sun when possible; (7) A pocket warmer or two in the foot of the bag is most luxurious on climbing in. A canteen full of hot water will serve the same purpose, and you'll have a fresh cool drink when you awaken.

Clothing Do's and Don't's

1. Keep clothing clean and dry at all times possible, to get maximum insulation from it. Wool shirts and trousers must be washed or cleaned at least every three months to maintain insulation properties.

2. Snow must be brushed from boots and clothing before entering any shelter.

3. Carry extra dry socks and dry glove liners if work entails exertion and possible sweating. To dry socks or gloves, put them inside the parka.

4. Keep clothing loose and free from binding, particularly on the feet. Get your clothing, particularly woolens, big enough to allow considerable shrinkage with moisture or washing. Any sock-boot combination must allow free movement of the toes, for constant toe and foot exercise when the feet begin to numb will prevent FREEZING INJURY.

5. Don't Sweat: Keep comfortably cool at all times. Underdress rather than overdress. This means you may spend much time dressing and undressing, but the effort pays off. If you get hot, take the following steps until comfortably cool:

a. Take your mittens off.
b. Loosen or remove belt or parka waist tie.
c. Open shirt or parka throat.
d. Throw parka hood back.
e. Shed pants.
f. Shed coat, parka or shirt.

ALWAYS WEAR AN OUTSIDE WINDPROOF IN THE ANTARCTIC

6. When through exercising, put on spare clothing BEFORE you chill.

7. Don't touch bare metal with bare hand at temperatures below freezing. They will stick, and you'll either lose some skin, freeze a hand, or be forced to urinate on the metal to warm it sufficiently for the hand to come free. If you stick both hands, you're in trouble.

8. Pull thumbs into palms, and arms out of sleeves and inside parka if they become extremely cold.

9. Keep your big mittens tied together and to you. If one or both are lost, a hand may be frozen. If clothes are taken off to keep cool, be sure they are safely stowed and will be dry when you wish to put them on again.

NUTRITION

(See also Survival and Trail Rations, pp. 127, 132).

Except under survival or primitive trail conditions, well-clothed, sheltered and trained men use little more food in cold than in moderate climates. In the cold, increased caloric intake is due partly to the extra activity of donning and doffing polar clothing and to the hampering effect and weight of that clothing in outside work, and partly to the ravenous appetite which accompanies the stimulus of cold. However, because the body "fires" burn somewhat hotter in cold weather, and because good food is a paramount morale factor, the Navy increases the ration by about 50% within the polar circles. Shipboard living calls for merely increase in amount of balanced diet; however, life on the ice, which is colder and more strenuous, calls for increased protein to rebuild muscle and glandular tissues, and for diet higher in fat content (this is not only craved, but is well tolerated), and for increased vitamins or vitamin-containing foods.

Foods come from animal and vegetable sources, and have three functional constituents:

1. Energy producing (ALL food)
2. Reparative (Proteins)
3. Vitamins, minerals and certain fats necessary for normal body functions.

In general, almost all nutritional studies have been done in the laboratories on rats. Agriculture has long been interested in food and fur animals: which factors produce the larger animals, the biggest litters, the finest furs, the most milk, etc. There have been few conclusive studies as to what is best for

man other than what varieties of foods he finds palatable. It is suspected that the diet best adapted for cold weather is one approaching that of the native Eskimo, high protein and fat - low carbohydrates. The survivors of Scott's northern party in 1912, Shackleton's entire crew in the Weddell Sea in 1916, and numerous other small groups, show that man can survive for long periods in good health on fat and protein alone. Stefansson's and Anderson's meat-fat diet observed by the Russell Sage Institute proves this point.

Energy Requirements: Should be more nearly tailored to the six-foot, 200-pound man than to the "normal" 165-pound man of usual calculations. Nansen was not only one of the greatest, but also one of the biggest of polar explorers. His expeditions were famous for the plentiful food of wide variety.

Due to increased metabolism and increased cooling, in the Antarctic, 5,000 calories per day is probably the minimum requirement for planning purposes and particularly for survival purposes. During the establishment of Army-Navy Drive from Little America V to Byrd Station in 1956, trail party personnel averaged 7.5 lbs of food/man/day (approximately 6,000 calories), yet each man lost five to ten pounds during the 65-day operation. Four New Zealanders, averaging 6'1" in height and 190 lbs. in weight did 1,200 miles on foot with dogs in 129 days at 4,800 calories per day with average weight loss of only one-half pound each.

Carbohydrates: These are the "quick energy" foods and they furnish only energy. Vegetable in origin, starches and sugars are hydrolized in digestion to simple sugars in which form they are oxidized to give energy. Composed of carbon (C), hydrogen (H), and oxygen (O), the end product of their metabolism is CO_2 and H_2O. Found in sugars, syrups, cereals and starch vegetables (potatoes, sweet potatoes, peas, beans and corn), these are the foods responsible for tooth decay. High carbohydrate diets have been implicated in some cases of hypertrophic arthritis.

Fats: The high energy food, fat gives 9.3 calories/gm, while protein and carbohydrate each give 4.1 cals/gm in metabolism. These natural sources for the fat-soluble vitamins A, D, E and K are both animal and vegetable in origin. Composed of C, H, and O (like carbohydrate), a fat is a molecule of glycerine combined with three molecules of fatty acid. Oxidized as fatty acids, they give energy with CO_2 and H_2O as end products. Fats are stored in the body as such. With excess food, carbohydrates and proteins are converted to and stored as fat. Fat-rich foods in the diet are butter, cooking oils, meat fats, lard, oleos, and margarine.

Fats give a diet its "staying" qualities, satiating appetite. Most "rich" foods have high fat content. "Indigestibility" is often a symptom of sluggish biliary system. Dehydrocholic acid, one or two 4 gr tablets taken with fat meals (e.g. pemmican) the first week or two on the trail may enable the gut to

handle these foods more comfortably, but interestingly, there is practically no gallbladder or biliary disease in cold weather, despite increased craving for and ingestion of fat.

Recent cholesterol-arteriosclerosis studies indicate that man's diet probably should contain less solid (saturated) fats and more fluid (unsaturated) fats than the average "civilized" diet now provides.

Fats and carbohydrates are called "protein sparers," since their presence prevents the body from having to burn its own blood and muscle to give energy. The body selects carbohydrates first to burn, then fat, then protein, because of ease in metabolism. Diets high in carbohydrates thus may allow excessively high cholesterol blood levels and storage (arteriosclerosis) by sparing fat utilization, no matter what type of fat is ingested.

Mixtures of 40-60 fat and carbohydrate appear to be best for cold weather diets for a number of complicated reasons. Fairly large quantities of fat are essential to a purely protein diet, as proven by the men who have died of "rabbit starvation" in the north after trying to live on this relatively fat-free meat alone. Symptoms are enormous appetite, distention, diarrhea, and death in three to eight weeks.

Protein: Reparative protein of both animal and vegetable origin, is found associated with the water-soluble B complex and C vitamins, and is an energy food equal to carbohydrates, but with additional valuable properties. It is composed of C, H, and O, and in addition nitrogen, sulfur, usually phorphorus, and sometimes iodine. Its chief end products are CO_2, H_2O, and Urea $CO(NH_2)_2$. Protein molecules are made up of some 25 or so different amino acids, of which eleven have been proven indispensable for normal growth, and seven for normal tissue maintenance.

Nitrogen balance is better maintained with small amounts of animal protein than with vegetable protein, because the variety of amino acids in meat is more nearly that required by man, and because meats are more easily digested than vegetables, giving a higher percentage of absorbed nitrogen.

The proteins with the highest to lowest biologic value to man are left to right: egg, milk, liver, lean meat, fish, whole wheat, oats, yeast, corn, rye, buckwheat, peas and beans.

It is interesting to note that whole wheat has 25% more biological value and almost two times the protein value of white flour, and that barley and rye have relatively higher protein values than other grains or vegetables.

Protein has another remarkable property, the specific dynamic action, by which protein, in its own digestion and oxidation, increases body metabolism

by 30%. This is a source of heat in addition to that normally produced by the muscles and the liver. In the cold, protein is an additionally protective food.

Because the by-products of protein metabolism are dependent on the kidney for excretion, water intake should be increased when more protein is eaten. This should be as water, fruit drinks, hot thin soups, or weak tea, but not coffee, strong tea and chocolate, which stimulate kidney function, cause dehydration and decrease the body's ability to readily excrete protein.

Vitamins: These essentials to health in normal climates are mandatory to life in cold climates because of increase in metabolism and stress concomitant with survival. The fat-soluble vitamins, A, D, E and K, are more stable to cooking and oxidation as a rule than are the water-soluble C and B complex. Because of vitamin destruction entailed in food preservation, storage and cooking prior to consumption, to be on the safe side, all hands in cold weather operations should take a daily multiple vitamin supplement. Those living and working on the ice probably should receive a "therapeutic" vitamin-mineral capsule with larger amounts and more complete coverage of requirements than those aboard ship.

1. Fat-soluble Vitamins (A, E, D, K)

a. Vitamin A in large amounts is found in the livers of polar bear (reportedly toxic amounts), seal, halibut, cod and sharks. Small amounts are in butter (17,000 U per pound), cheese, cream, beef and lamb fat (but not in hog fat), and egg yolk. Carotene found in most green and orange colored vegetables and fruits is turned into viatmin A in small amounts in man's small intestine and liver. 5,000 U per day prevents zerophthalmia, night blindness, and severely scaly skin. Large amounts (25,000 - 100,000 U per day) will cure acne, improve photophobia, increase night vision, prevent epithelization of normal columnar epithelium, and lower the blood pressure of some cases of hypertension. It promotes growth of children and adolescents. It is suspected that it increases resistance to infection, prevents formation of kidney stones, and does many other remarkable things promoting optimum health and comfort. With the knowledge that the further north the fish is caught, the higher the liver A content, and with the knowledge that the most potent source of A known is the liver of the polar bear, it is reasonable to assume that men going to polar regions need a minimum of 15,000 - 50,000 U of vitamin A per day for optimum health. This cannot be had from foods, but must come from a supplement, and one which will not at the same time give more than 1500 units per day of vitamin D.

b. Vitamin E comes from wheat germ oil, and is one of the vitamins commonly lost in the shelling, milling, and bleaching of white flour. It is called the antisterility vitamin, but its principle value in man seems to lie in its ability to protect vitamin A from oxidation, or to promote A's absorption. Blood vitamin A levels are three times as high if E is taken with the A as when A is taken alone.

e. Vitamin D is the antirachitic vitamin produced in nature by ultraviolet irradiation of the skin with transformation of dihydrocholesterol into vitamin D. It is necessary to maintain the normal calcium-phosphorus deposition in bone and in the blood stream. It is obtained in very small amounts in butter, fat, eggs, liver, irradiated milk, cereals, and certain fish. Because of the inability to get sufficient ultraviolet irradiation for months in dark polar regions, man in these areas should get 800-1500 U daily of supplemental vitamin D.

d. Vitamin K, necessary for blood clotting, is manufactured by bacteria in the gut and is absorbed as long as bile is present in the gut. No reason for supplementation is known at this time.

2. Water-soluble Vitamins (C, B Complex)

a. Vitamin C is the antiscorbutic vitamin cevitamic acid or ascorbic acid which prevents scurvy, first isolated in 1928. It is readily destroyed by heat, sun and oxidation. Because boiling, drying, aging or storage of foods reduces or abolishes vitamin C content, scurvy was formerly the plague of polar explorers. Vitamin C is found naturally in citrus fruits, tomatoes, cabbage, turnips, spinach and raw meat. Ascorbic acid prevents suprarenal hypertrophy in the cold. In all animals it increases resistance to cold and limits cold's damaging effects.

Vitamin C is necessary to maintain the intercellular substance in tissues, particularly capillaries. It maintains normal wound healing and promotes normal red blood cell formation. Deficiency causes capillary fragility with hemorrhages, swollen tender gums, painful joints, and extremities with low resistance to freezing.

Normal requirements in temperate climate is 50-100 mg. per day. Polar supplementation to 100-200 mg. per day is recommended.

b. Vitamin B Complex. These twelve known water-soluble vitamins are found in association in grain polishings and in dried brewer's yeast. Deficiencies of one are rarely found without deficiencies of another, so all should be given together on all occasions when supplementation for deficiency is indicated. In general these chemicals are required for utilization of energy from starch and sugars.

(1) Thiamine (B_1): Prevents polyneuritis, fatty liver, atony of musculature in the gastrointestinal tract, and heart failure from beriberi. It is found in lean meat, liver, whole grain cereals, legumes, peanuts, and many green vegetables.

(2) B_2 Complex.

1. Riboflavine (G_2 or G). Lack of this element causes sore corners

of the mouth, rough, purplish, sore tongue, scaly skin, and burning, teary eyes. It is found in liver, lean meat, eggs, milk, cheese and green leafy vegetables.

2. Nicotinic Acid. Lack of this vitamin causes mental depression, forgetfulness, loss of appetite, diarrhea, and death from pellagra. Sources are lean meats, liver, fish, whole grain cereals, green leafy vegetables. (For unknown reason, 50 mg. of nicotinic acid (not nicotinamide) every four hours with like amount of ascorbic acid, will relieve almost any sore throat in about 12 hours.

3. Pyridoxine (B_6). Lack of this vitamin causes dermatitis, insomnia, irritability, and abdominal pains. It is found in lean meat, yeast and wheat germ.

4. Pantothenic Acid is somehow involved with riboflavine and thiamine in converting carbohydrates and protein to fat.

5. Choline	vs. liver cirrhosis	found in liver, meat, and yeast
6. Biotin	vs. skin rashes and muscle pains	
7. Inositol	vs. liver cirrhosis (in fat-free diet)	
8. Para-amino Benzoic Acid	vs. skin disease	
9. Folic Acid	vs. pernicious anemia	
10. Vitamin B12	vs. pernicious anemia	

11. The flavonoid, rutin, found in buckwhat and paprika, and hesperidine, found in citrus fruit pulps, are related to the B_2 complex. They seem almost as essential to normal blood capillary function as is vitamin C.

Minerals. Calcium, iron and iodine are likely to be deficient in the usual diet unless extra milk, red meat, and iodized salt are furnished. With cold acclimatization dehydration, there is dimished appetite for salt; in fact, Eskimos rarely, if ever, use salt. (They do eat much fish, however, and keep up their minerals in this way.) The body also has requirements for phosphorus, copper, manganese, magnesium, zinc, cobalt and molybdenum. To assure sufficient of these minerals for optimum health of wintering-over parties, a daily supplementary vitamin-mineral capsule seems indicated.

Provisioning.

Using the physiology text of Best and Taylor as reference, the best average temperate diet follows. With it is shown the recommended cold weather diet:

FOOD ELEMENT	TEMPERATE	COLD WEATHER
Carbohydrates (4.1 cal/gm)	53%	40%
Fats (9.3 cal/gm)	35%	40%
Protein (4.1 cal/gm)	12%	20%
First-class Proteins, Meat, Milk, Eggs	40% of 12% above	50% of 20% above
Total Calories	3500	5000-5500

Considering that animal protein sources are 20% protein and 80% water, increase of 50% in diet, whether by weight, by cost, or by calorie seems best invested in extra animal protein (meat, fowl, fish, milk, eggs) than in any other food element if maximum health is the goal. This at the same time increases fats to the required level.

1. Caffeine-free coffee is indicated for men living and working in the cold to combat dehydration and diminish mental tension.

2. Corn oils should be used for cooking rather than coconut, cotton-seed, or olive oils, for they contain more vitamins. Mineral oils should be avoided completely because they inhibit the absorption of fat-soluble vitamins.

3. Whole wheat, rye and buckwheat flour should be used in preference to white flour where possible.

4. Low-pressure dehydrated fresh-frozen citrus juices should supplant canned juices where logistics permit, because of the greater Vitamin C and flavinoid content.

5. Diets of air crews and parties in cold and high altitude (Pole Base) should have milk ration increased by 30% to 50%.

Cooking

Tips on cooking to maintain highest food value, vitamin and mineral content:

1. Never boil fruits or vegetables in soda "to improve the color."
2. Do no cooking in copper-lined or copper vessels.
3. Cook all meats (except pork) as rare as the crew will eat it.
4. Save all juices in which meats or vegetables are boiled and put them in soups, saving vitamins and minerals.
5. Cook rapidly at higher pressure in pressure cookers, particularly at altitude, to conserve vitamins.
6. When cooking in a tent, DON'T BOIL foods, for the steam will ice the tent. Bring it to a boil and eat it more or less raw if necessary.

Nutrition Do's and Don't's

1. Eat your full daily ration, rather than stuff on candy and peanuts between meals. Take the vitamins offered in the amounts suggested. Deficiency diseases are disabling and may make you a liability to the expedition.

2. Eat your share of figs, prunes and raisins, the natural cathartics, drink plenty of water, and maintain a regular bowel habit. On the ice, constipation is painful.

3. Eat all soups offered and drink one to two glasses of water or juice at each meal to keep up water balance.

4. Don't overeat - its easy to quickly put on 20-30 pounds with the voracious appetite normal to cold climate. Excess weight makes you a cardiac liability.

SANITATION

Water

Few sources of fresh water will be found in Antarctica. The few summer lakes or ponds which are found away from inhabited areas are believed to be safe for drinking, though esthetically they may not be too palatable because Skua gulls have dirty habits.

Glacial ice gives roughly twice the water per fuel unit in half the time that snow does when melted. In addition, snow more often contains dirt, soot, animal and human contaminants.

Chlorination of water sources is not generally necessary in Antarctica, except at large bases with limited snow supplies, or where pet dogs have contaminated the source of melt snow. Chlorination or boiling is MANDATORY in the Arctic. Purification of mountain stream water is advisable; springs are usually safe. In Arctic or mountainous areas all hands should have current typhoid immunization.

Don't try to eat ice or snow. A day or two of taking water in this manner gives a swollen, raw mucous membrane in the mouth which may be so painful as to prevent eating or drinking until the inflammation subsides. Dogs eat snow and get away with it; humans can't.

Small arctic lakes are satisfactory for summer and early fall water, except during and shortly after the summer thaw, but in winter and spring the lake should be over eight feet deep, for with freezing, mineral content is so concentrated (e.g., dissolved iron) as to be unpotable without processing. Dangerous coliform contaminants do not appear to long survive in Arctic lake water.

Man should drink two to three quarts of water per day. Cooking, dishwashing (without automatic dishwashers), clothes washing, and personal ablution on a weekly basis takes ten to fifteen gallons/man/day under austere conditions.

Sewage and Garbage Disposal

Antarctic. Camps built on ice shelves or glaciers most easily dispose of sewage and garbage in flagged pits dug in the snow or in tidal cracks at a safe

distance below water sources and away from commonly traveled trails. Once dumped, whether buried or not, it is rarely a public health hazard, for the refuse will freeze and there are no insects or rodents to spread disease.

Camps built on land may have to transport this refuse in halves of oil drums or in heavy waterproof paper bags some distance to a place where tides or currents of sea water will carry it away with the next seasonal thaw.

Because melting of snow and ice for water takes so much fuel, until atomic power furnishes an excess of electrical or steam heat which can be used for making water and for heating air-insulated double plumbing, flush toilets are a logistic luxury. .

Arctic. Infrequent and expensive but most effective are sewage disposal plants. Private cesspools and privies are a source of contamination of stream and well water sources. Because of permafrost and the annual low temperature, auto-digestion tanks are not practical in most areas.

Sewer outlets and garbage dumps contaminate many beaches. Safest disposal is as in the Antarctic land bases, except that the waterproof paper bag sewage disposal system with incineration would be preferred, utilizing trash and waste oils and fuels to help in the incineration. In the Arctic rats and flying insects potentially can spread enteric disease in epidemic proportions. This burning should be done at least one mile downwind of habitation and particularly aircraft runways, for charred remains are black, and anything black melts holes in snow or ice runways if the sun is up. The sanitary fill method of garbage and sewage disposal is prevented in most polar locales because permafrost is hard to handle even with heavy equipment.

As additional sources of water pollution, in many parts of the north fish canneries and paper pulp mills contribute noxious wastes to nearby waters.

In centers of polar civilization, an expensive but practical solution to water supply and sewage disposal is a conduit system containing water, sewage, steam, telephone, and electric systems in one underground passage.

Chemical toilets are an advance in sanitation, but disposal of the contents is a problem. Electric "incinamodes" are luxurious, but are not at this time rugged enough to handle a practical workload economically.

Food Storage

In polar camps food should be used in rotation, with older supplies being eaten first. This saves much work. Meats should be kept in refrigeration (even on some peripheral Antarctic land bases mild summer thaws in the past have been responsible for much spoilage) and should be kept tightly wrapped in oil

paper or plastic to prevent dehydration (freezer "burn") and peripheral fat oxidation (rancidity). Butter and other fats should be kept frozen. Eggs (treated with water glass or oiled, packed in flour), pickles, fresh fruit and condensed milk should not be allowed to freeze. Canned goods may be stored frozen or unfrozen, but repeated freezing and thawing destroys many items. This also causes fresh frozen milk to precipitate. Most fresh frozen foods are spoiled if allowed to thaw and refreeze once or twice. Whole grain flours should be kept frozen. Weevil eggs present in all flour develop and multiply much faster in whole grain than in refined or processed flour. They know what's good for them! In the Arctic, perishable foods such as meat and fish have been successfully stored in chambers dug down into the permafrost, utilizing natural refrigeration.

Food Handling

Standard sanitary procedures work well in cold climates. Lower temperatures fortunately prevent much spontaneous growth of contaminating organisms and limit such occurrences as staphylococcus food poisoning, common to tropical and temperate zones.

Field dishwashing can be done well by use of four big galvanized iron cans: the first to take garbage, the second, hot water detergent wash; third, hot water rinse; and the fourth a hot rinse containing germicide. The washes are kept hot using immersion heaters.

Housekeeping

All habitations should be swept out daily and kept tidy. Refuse should be burned and/or buried regularly. A dirty, untidy camp is a fire hazard, is hard on morale, and in the Arctic an untended garbage "midden" will in season attract undesirable animal and insect life.

INFECTIOUS DISEASE

Antarctic. There are no known infectious diseases in Antarctica; however, occasionally disease is imported from the last port of call, and sound public health measures must be utilized. In one instance a man was discovered quite ill with epidemic meningococcus meningitis. The physician wisely isolated the case and put all hands on prophylactic sulfonamides. (Fortunately the strain of meningococcus was not sulfa-resistant.) The case recovered uneventfully without spread of the disease. In another instance, a man in a large camp came down with infectious hepatitis. Isolation, evacuation of the case, and one week of disposable paper plates with boiling of other tablewear prevented spread of the infection. Because of cramped quarters and primitive living conditions, stringent precautions must be utilized to prevent flash epidemics.

Arctic. The Arctic has many infectious diseases which have taken high toll

from time to time particularly in native populations where crowding, poor sanitation, starvation, and exposure are accentuating factors. The diseases are as follows:

1. Infectious Disease

a. Respiratory

(1) Pulmonary tuberculosis caused by the tubercle bacillus, spread by droplet infection and by poor sanitation, particularly in crowded dirty native quarters. (In mentioning tuberculosis, this is often a concomitant and/or a predisposing factor causing phlyctenular keratoconjunctivitis, a disease causing much blindness among poorly-fed and poorly-housed natives. Some blindness is also caused by the scars of herpes simplex of the eye.)

(2) Virus

(a) Common Cold. This is reported as rampant among oldtimers in polar camps when outsiders enter camp. Observations in Antarctica show that there is over four times the rate of infection among newcomers as among oldtimers in the first 30 days of a summer operation. These cases peak on the 10-13 day; there is a minor secondary wave on the 20-21st day; and a third wave on the 27th to 28th day with the few cases among old timers occurring only in the first wave on the 10th to 13th day. We believe that immunity is not lost through isolation; that fatigue, dehydration, sudden chills, travel through several populations en route, unusually dry air, excessive smoking, and possible avitaminosis are the precipitating factors in the newcomers' infections. Regular hours, acclimatization and vitamin supplementation seem to protect the oldtimers. Acute upper-respiratory infection is most rare during periods of isolation, but outbreaks have been reported after opening a new box of fur garments during the winter. This appears to be retention of a potent virus in the fur, probably from a native of the north who made or wore the garment initially.

(b) Influenza. True influenza has not been observed in the south. In the north the same resistant factors mentioned in discussing the common cold prevail. There is a moderately febrile malaise-accompanied acute upper-respiratory infection with few physical findings, cured without sequellae or relapse with 36-48 hours of bed rest, forced fluids, salicylates and whisky, which probably should be called "catarrhal fever," particularly from the epidemiological, statistical and prevention points of view.

(c) Infectious mononucleosis. This infection of the lymphatic system characterized by acute sore throat, tender cervical lymph nodes, and occasionally prolonged weakness and debility, is probably of viral origin and seems to be more prevalent in cold climates.

b. Enteric Infection

(1) Enterobacteria

(a) Salmonella

1. Typhoid Fever. An acute febrile and highly fatal infection of the gut, contracted commonly by feces, filth and fly contamination of food or drinking water. It is preventable by inoculation (see p. 15).

2. Paratyphoid Fever. Similar to typhoid, less fatal, prevented by the above-mentioned typhoid-paratyphoid inoculation.

3. Typhimurium. This is a mouse typhoid, which organism is a source of food poisoning in man (rodents starve in clean camps).

(b) Shigella. These cause the bacillary dysenterics of man, debilitating to adults, deadly to babes. Like typhoid, these are spread by poor sewage disposal, filth, flies, and food contamination.

(c) Clostridum. Type E botulism has been found in native preserved whale, seal, and fish eggs. The botulinus organism thrives in improperly home-canned preparations. The toxin produced by the organism's growth is very deadly unless destroyed by thoroughly boiling infected food before eating it.

(2) Virus

(a) Infectious Hepatitis. Virus is spread by fecal contamination. It causes a debilitating liver infection featured by jaundice.

(b) Poliomyelitis. A virus probably spread by fecal and fly contamination as well as by nasopharyngeal droplet. Infection has from time to time decimated native populations in the Canadian North. Immunization is possible by oral administration of three attenuated strains of the virus.

(c) Herpes Simplex. The virus of "cold sores" of the mouth (and occasionally the eye or genitalia) is more frequent in cold climate. This is neatly treated with a daily cowpox vaccination for three days.

Antibodies to the adeno viruses, the ECHOviruses, and the psittacosis virus have been found in the blood of Canadian natives.

(3) Parasites. Diphylobothrium latum or fish tapeworm infection is contacted by man eating inadequately cooked worm-infested fish.

2. Animal-born Disease

a. Trichinosis. Caused by the worm trichinella spiralis. It is found in beluga (white whale), arctic fox, red fox, wolf, wolverine, walrus; black, Kodiak, grizzly and polar bears; and Eskimo dogs of the Arctic. This tiny roundworm or nematode is ordinarily found encysted in the muscles of the rat, pig, and man. It is contracted by eating infested meat incompletely cooked. (Under survival conditions it is better than starving.)

b. Echinococcus. A small tapeworm inhabiting the gut of wild wolves and foxes. Eggs in these feces are ingested by caribou and moose which develop visceral cysts. Dogs eat raw caribou viscera, and humans not practicing good hygiene and sanitation become infested from dog droppings.

c. Tularemia. A bacillary blood infection contacted by man handling infected rodents--ground squirrels, hares, etc. This disease, also called "deer-fly fever" and "rabbit fever," is endemic but of low incidence in Alaska.

d. Rabies. This acute and deadly infection, borne by the bite of infected animals, is endemic in Alaska, particularly in the fox population. Occasionally it is carried by wolves, dogs, and other carnivores.

"Spekk-Finger" (Norwegian for blubber finger), or "seal finger," is an acute infection of the hand to be found among men who skin seals with bare hands. Through cut or abrasion of the skinner's finger an acute infection of unknown cause (micrococcus, streptococcus, staphylococcus, or coryncbacterium have been suspected) starts in 3-21 days. The finger swells, throbs, gets red and

distended. Bone and joint involvement is common and pain seems out of proportion to physical change. There is no pus formation and patients remain relatively afebrile. This infection is successfully treated with aureomycin. Prevention depends on using rubber gloves, use of soap and water thoroughly and frequently, prompt treatment of any cuts or abrasions, and avoidance of seal skins, particularly the skins of old seals, until all hand cuts are healed.

TRANSPORTATION

In brief, transportation depends on the same criteria, and combinations thereof, as a good newspaper article: who, what, why, when, where and how.

1. Arctic
   a. Summer
      (1) Land. Lakes, rivers, tundra and bogs make overland transportation in summer virtually impossible. Boats, rafts, kayaks and oomiaks are of limited use, and are more or less dangerous unless used by experts with great knowledge of local conditions.

      (2) Sea: Icebreakers regularly open the Siberian Arctic to summer shipping from Archangel to Vladivostok. The American Arctic has been navigated by icebreakers from Atlantic to Pacific. Helicopter scouting for leads and polynas in the ice have advanced this art.

   b. Winter
      (1) Land. Freezing and snow make overland travel possible but rugged by:

      (a) Walking, utilizing snowshoes or skis depending on depth and type of snow, availability and skill.

      (b) Sleds, toboggans or akjas pulled by men, dogs, reindeer, Siberian ponies or machines.

      (c) Automotive equipment, from modified automobiles, trucks and tractors to specially designed motor toboggans and multiple-tractor vehicles.

      (2) Sea. Varying in extent, solidity and thickness from year to year, northern waters freeze, making sea travel within the Arctic Circle impossible even for present icebreakers.

   c. Year-round. Fixed-wing aircraft from tiny two-seaters to giant transports, equipped with skis, pontoons or wheels depending on season, weather and facilities, and helicopters have truly facilitated the logistics of exploration and life in the polar regions. They have also introduced unique problems in search, rescue, safety and survival of downed aviators.

2. Antarctic
   a. Summer
      (1) Land. As in Arctic winter and year-round (above), except that snowshoes are of little or no value in the Antarctic.

(2) Sea. Icebreakers make sea transportation for cargo ships possible every year through the pack ice to most of the periphery of Antarctica as far south as 77°51'(McMurdo Sound).

b. Winter. Due to more or less constant darkness, extremely low temperatures and high winds, unbelievable distances, and limited facilities, midwinter transportation at this time is limited to extremely dangerous flights. Pack ice makes sea transportation inside the Antarctic Circle impossible even to icebreakers from March to November. Following the example of North Polar atomic submarines, contact with continental peripheral Antarctic bases is conceivable, although with present knowledge it would be perilous.

Driving the ALCON Highway to Alaska

1. Have in your possession upon reaching the Canadian Border at least $300.00 in cash, traveller's checks or credit cards, for expenses of the driver and vehicle, plus $75.00 for each adult passenger. Pay attention to rates of exchange, and when you first enter Canada, change some of your money into Canadian money at a bank rather than at business establishments, which sometimes charge excess differential if the U.S. dollar is less than the Canadian dollar, or may not give credit when the reverse is true.

2. Purchase a copy of the "Milepost" or similar publication, readily available at the southern entrance to the ALCAN highway. These list facilities along the highway, mile by mile, and services offered. If driving in winter months, inquire as you go along to make sure facilities you plan to use are open year around.

3. Your car should be in good repair before you start. Parts and repairs are expensive and large inventories are not stocked. You may have to wait until a part is air freighted in.

4. If you plan on using gasoline credit cards, make sure that your company and/or their affiliates have service stations along the Alaskan highway. If you do not carry extra gas, don't pass a gas station if you have less than half a tankful.

5. If you break down during the daylight hours, remain in the car and tie a white rag to the outside mirror or other appurtenance on the left side of the car. Have a set of highway emergency flares or reflectors in case you stop or break down on the highway during the hours of darkness.

6. Year around a tow chain or cable, sleeping bags, axe, shovel and fresh water should be carried. Don't forget your survival kit, first aid kit, fishing gear and camera.

7. In winter months, put natural rubber tubes in your tires whether or not you have tubeless tires. Tire chains are mandatory.

8. Between April and November, headlights should have "Mae Wests" and door mat should cover the underside of your gas tank to protect from flying stones.

9. Allow sufficient time for your trip. You should not exceed 50 miles per hour on the Alcan Highway.

10. If camping or tenting along the highway, put out your fires, don't pollute streams, and leave a tidy camp for the next traveller.

11. Should you need assistance, contact the nearest Canadian Army Maintenance Camp, located approximately 100 miles apart along the highway.

12. The weather is always a topic for conversation in Alaska, because of the wide range of temperatures occurring during the year. In spite of cold, work and social life continue in weather that normally would keep "southern 48" citizens at home. The difference lies in sensible clothing of several light layers, which provide protection, yet allows easy adjustment to daily temperature differential. Use common sense, dress sensibly, and respect Mother Nature, who is cruel to the unprepared.

SLED-DOGS

Sled and pack dogs have been used in the North since time immemorial. They are still used extensively in Antarctica by the English, Australians, and New Zealanders. Man-hauling of casualties on an akja or toboggan takes two to six men, depending on snow conditions. It takes one man and seven to nine dogs to do the same job, and they will do it faster, though this calls for trained men and dogs. Its still a form of transportation which reproduces every 18 months, and one which men (and dogs) can eat. They function best in the field when supported by aircraft to keep food loads lighter.

Breeding

The American Kennel Club recognizes four breeds of sled dogs which are more or less wolflike in appearance. Some say that North American natives occasionally tie a bitch dog in heat out in the woods in hope that a little wolf strain in their team will increase their stamina. The most famous dogs of the north for hauling or carrying loads, the fastest and smartest, the boldest and bravest, the greatest pranksters and the most deadly killers have been crossbreeds of Huskies and Malemutes with wolves, Collies, St. Bernards, Labradors and other big dogs. The most useless dogs are usually also crossbreeds. In the wilds it is said that differentiation depends on the dog keeping his tail up in a sickle-shaped plume over his back, the wolf's tail slinks down below his hind quarters.

1. Samoyed dogs were bred by the Siberian Sayantsi people, a Finn-Mongol

tribe living between the White Sea and the Yenesei River. These all-white to cream-colored "Spitz," smallest of all sledge dogs, were used by Nansen, Borchgrevinck, Scott, Shackleton, Due d'Abruzzi, and others. Broad flat head, wide-set eyes, height 18"-22," weight 36-55 lbs., short body, and lower hind quarters than shoulders, mark this gentlest of sled dogs. It is also a good watch dog and pet.

2. Siberian Huskies, next smallest, but fastest of all sled dogs were bred in the Kolyma River region of northeast Siberia. Usually gray with white or black markings, shorter fur, fox or police dog head, lighter eyebrows and muzzle, blue or brown eyes, weight 40-60 lbs., height 20"-23-1/2", long legs and relatively short body mark this one-man dog which rarely fights his own breed but attacks all others. He has the toughest feet of all breeds, but they are not as good in deep snow as the bigger dogs. They have been used much and interbred with other dogs in Alaska.

3. Alaska Malemutes were bred by the Innuit tribe of Eskimos living near Kotzebue Sound, Alaska. These thick-coated wolf-gray or black and white dogs were used by Byrd. Broad of head with bear or shepherd-like head, obliquely set wolflike eyes, these dark-capped dogs fold back their wedge-shaped round-tipped ears when they work. Weighing 50-85 lbs. and 20-25" tall, these big, friendly, affectionate dogs have big "snowshoe" like feet which function well in deeper, softer snow. They have relatively long bodies.

4. The Eskimo or typical Huskie prooably originated in eastern Siberia. Now found from Alaska to Greenland (used by Peary and Amundsen) they may be differentiated from the similar Malemute by being black, white, brown, gray, buff, or any combination of these colors; having a "chow"-like head with high forehead and sharp ears; having the longer fur; large, longer "flattish" feet; and by having a chow-like pugnacious disposition, not to be trusted with other dogs or animals. These dogs can't bark; they yelp or howl. They are keen hunters and have a great memory for trails.

Behavior

Sled dogs have personalities as varying as those of people. Study of individuals and their habits should always be a constant interest of the driver if he will enjoy and get the most out of his team. Some dogs simply don't get on together and must be used in different teams. Fights must be broken up if all attack one, and fights must never be allowed on the march. In camp, some bullying by leaders is normal. Fight wounds usually heal normally without care.

Training

Training dogs from one family or clan is usually easier, for they get on better together. Bitches, though averaging 10-15 lbs. lighter, make excellent lead dogs and are said to liven a team. Pups are easily trained by following

their bitch at 6-9 months of age. Teams must be trained to follow oral command from the rear. The whip, mark of authority, should be used as a punishment only with the thong doubled, and the beating should be sufficient that the dog knows obedience is expected. Good routine is 90 minutes run with 10 minutes rest to de-ice and untangle harness. NEVER let dogs get in the habit of following a man on foot. Teams must be regularly exercised together or they quickly forget their training. Petting is frowned upon except at the end of the day's run.

Feeding

In camp each dog gets 9 lbs. of seal meat every three days. On the trail they are fed once daily at the end of the run with one pound of dog pemmican (for the average-sized dog.) In the north, fish may be substituted for seal meat or pemmican. A fairly good dog pemmican formula from New Zealand is:

Meat Meal	42%	Wheat Germ	5%
Tallow	40%	Molasses	2%
Whole Wheat Meal	10%	Cold Liver Oil	1%

Tethering

In the north many drivers tie up only the troublemakers. In Siberia drivers always tie up dogs in camps where there also may be reindeer, for untied, the dogs invariably kill two or three. On the trail, time will be saved, and fights between teams will be limited, by chain-leash tethering to chain picket lines.

Loads

Dogs may be expected to pull a load of half the total weight of the dogs at a gallop up to 20 mph on good snow, loads equal to the weight of the dogs at 6-8 mph, and loads 1 1/2-2 times the weight of the dogs at 2-4 mph (but they may need help breaking the runners from the snow).

Teams

Teams consist of 5-15 dogs. Driven single file or double file (Alaskan hitch) calls for a good lead dog. The advantage here is that there is less trail breaking per individual dog in loose or deep snow, but fights badly tangle the harness, and shirkers may not pull their share. They may be driven on individual traces of equal length in a "fan." The dogs like this, fights are easier, but each dog must break his own trail, and dogs on the sides lose mechanical efficiency. Individual traces of differing length allow better trail breaking and efficiency, and trouble-makers may be tethered closer to the sledges. Again fights badly tangle traces.

Dog Do's and Don't's

1. Don't lie down near an untied team--they may mistake you for a seal.

2. If you fear a dog he can smell it, and gentle overtures to gain his friendship may cost you a hand.

3. Even if you love ALL dogs (and they like you), don't spoil the other fellow's team by over-attention to his dogs, and don't spoil a strain he may be trying to perfect by letting your own dogs run wild.

4. In dishing out a pat or a roughening to your team, treat all as equals—dogs resent favoritism.

5. Doubled whips or whip handles break up dogfights more quickly and far more safely than hands and with less damage to the dogs than axe handles.

6. Don't leave rags soaked in animal fats about camp. Dog eats rag, rag blocks dog's gut, dog dies.

7. Don't use dogs at elevations over 8,000-10,000 feet; they don't do well.

8. Don't use dogs to break trail for tractors, for they easily cross crevasse bridges which will not support tractors.

9. NEVER defecate upwind and in sight of a dog team. Their pursuit of delicacies may lead to painful bites, and man neither runs or dodges well with his pants around his ankles.

LOGISTICS

1. Bulk supplies should be thoroughly yet economically insulated, packed and crated in keeping with contents and roughness of handling, in boxes of size and weight to be easily handled. Boxes should be indelibly numbered according to contents and color- or letter-coded as to base, department, etc. Master lists of contents, codes and box numbers should be maintained at both rear and advanced bases to expedite ready availability.

2. Contents spoiled by freezing or thawing must be expeditiously moved to cold or warm storage as the case may be. In continuous polar daylight, white boxes reflect and black boxes absorb the sun's heat. (Black boxes should have white bottoms to prevent melting of snow or ice beneath.)

3. Storage in the open should be in thoroughly flagged lines parallel to prevailing winds to minimize loss in drifting snow.

4. Fabric supplies, tents, clothing, climbing ropes, etc. should be cleaned, dried and repaired before being restored.

5. Metallic supplies should be dry and treated with grease or silicone rust inhibitors before storage.

6. Firearms, ammunition, narcotics, alcohol and liquor supplies should be given proper security storage.

7. Every camp or outpost should have a "safety camp" or shelter at some distance from the main camp with adequate stores of clothing, sleeping bags, food, fuel and medical supplies, and communication facilities, in case of major fire or other calamity in the main camp.

8. Bottles of solutions which may be frozen without chemical damage must have 1/5 to 1/3 excess air space to allow freezing without bottle breakage.

9. Frozen plastic and rubber must be handled gingerly until slowly and thoroughly thawed to prevent breakage.

POLAR MEDICAL DISABILITIES

During Operation DEEP FREEZE, the Medical Department has stressed the prevention of Polar disabilities rather than the treatment, with the result that we have had few of these cases to treat.

VISUAL

Snowblindness

This results from the burning of the conjunctiva by ultraviolet rays of 200 to 300 millimicrons wave length. As in actinic conjunctivitis from electric arc lights, the symptoms are always delayed from 2 to 12 hours or more after exposure, there being no warning until after the damage has been done. Symptoms are:

a. Extreme pain due to the swelling of the conjunctiva, and so severe that on one occasion a polar physician so affected attempted suicide.

b. Photophobia. The subject becomes almost totally dependent on others, because of the inability or reluctance to open the eyes from the pain which this causes.

c. Lacrimation.

d. Smarting, scratchy eyelids

} These further limit the ability of the patient to use his eyes.

e. Headache and depression. Probably as much as to ultraviolet rays, these

are due to the effect on the retina of (a) glare, from visible light waves of 400 to 700 millimicrons wave length and of (b) calorophthalgia, a condition described by the author following research on dark glasses in Antarctica. It is caused by infra-red waves of 700 to 1,000 millimicrons wave length.

Snowblindness symptoms last one to five days, depending on the severity of exposure, but once severely affected, subjects have noted remarkable photophobia and tendency to repeated snowblindness even with lesser degrees of exposure for periods of five to seven years. Oddly, snowblindness is contracted more often on overcast days, particularly under "whiteout" conditions, than when the sun is shining brightly on the snow.

Under these overcast conditions, the snow scene may appear grayish and darkened and the novice assumes he will be safe without dark glasses. A photometer, however, will disclose the true conditions of illumination, for recordings are much higher than on sunny days.

Prevention

1. On bright sunny days, the nose and upper cheeks may be lamp-blacked to help diminish glare, but this will not prevent snowblindness.

2. Glasses for Ground Personnel. In Polar climes, dark glasses of suitable type and configuration must be worn out-of-doors at all times that the sun is above the horizon. Glasses with side blinders, goggles, or glasses with frames which curve postereo-laterally are necessary to prevent snowblindness from lateral light. Under average summer operating conditions, in the Antarctic, fogging of glasses from breath and from skin vaporization is an almost disabling problem with the first two mentioned types. We have found that a well-curved frame gives sufficient periorbital air circulation to prevent most fogging, yet gives good protection from lateral light. Maximum light transmission allowable for comfort from glare, yet which reflects good vision, was found to be 15% of white light. Neutral gray color was preferred by 72% of test subjects. Electronically coated nickel on the front of the lenses simulates the gold or platinum glasses of Imre. With heavy nickel application to upper and lower sections of each lens, grading imperceptibly toward a central light area, the Eskimo stenopeic slit-goggle principle further diminishes glare from sky and snow. A combination of the above principles was perfected at the end of the first year and has not been changed for the past nine operations. The DEEP FREEZE dark glass (for wear at all times except when flying as a pilot) is the Bausch and Lomb (Rochester, New York) G-15, neutral gray glass with Double Gradient Density "Inconel" metallic coating, in the "Outdoorsman" frame. These are ground to prescription, including bifocals. To our knowledge, this is the only company in the world which is tooled to make these glasses. The Russians have attempted a facsimile, but they are said not to be as good because the metallic coatings are not gradient. Prices range from $15 to $30 (£5 to £10) depending on the complexity of prescription.

Everyone, whether they customarily wear a correction or not, should be refracted, preferably under cycloplegic, (if under age 40-45) before being given dark glasses; for when the light is cut sufficient for comfort and protection (15% or less), even small refractive errors make vision subjectively unsatisfactory.

Should glasses be broken or lost in a crash, the eyes may be protected by (a) wearing a muffler or stocking cap which can barely be seen through over the eyes; (b) wearing home-made stenopeic or Eskimo "Slit Goggles" made by cutting a horizontal 1/16" to 1/8" wide by 1" to 1-1/2" long slit for each eye in a "lens" of leather, shell, cardboard, metal, etc.

At temperatures lower than -20°F. -30°F. metal spectacle frames may cause painful local frostbite if they touch the cheek. This is easily and cheaply prevented by splitting a length of the plastic "spaghetti" (which is ordinarily used to prevent chafing of metal spectacle temples behind the ear). Attached to the bow hinge by a small punctured hole, through which the temple is pulled, the slip spaghetti is laid around the bottom of one frame, wrapped or tied at the bridge, then similarly continued around the bottom of the other frame and similarly attached at the opposite frame-temple junction.

Treatment of Snowblindness

1. Rest in a darkened room with bandaged eyes and cold compresses (for pain) for 1 to 5 days.

*2. Butyn drops or ointment (for extreme local pain).

3. Sedatives, barbiturates or tranquilizers (vs. depression).

4. 2 to 4 drops of astringent every four hours consisting of:

R_x	Zinc sulfate	gr. 1
	Boric acid	gr. 1/2
	Adrenalin HCl	1:1000 m $\bar{x}$
	Water up to one ounce	

5. Atropine or homatropine drops for extreme or painful ciliary spasm (tiny, painful pupil of eye).

6. Multiple vitamin capsule containing vitamins A, E and C, one to three daily (on general principles).

7. Antihistamines orally and cortisone drops may help.

*DO NOT use cocaine because of its softening effect on the corneal epithelium.

WHITEOUT (See WEATHER, p. 2)

Fortunately, complete whiteout is quite rare, for well over 95% of the time there is some bit of horizon visible somewhere in the 360° circle. In complete whiteout, there may be no form of assistance to man.

In the average whiteout, man on the ground without horizon ahead becomes disoriented and falls unless he can see another man, trail flag, or tractor ahead to discern which way is up. Crevasses, vehicle and man tracks, and snowy obstructions become invisible. Fliers in conventional aircraft must go on instruments, and a number of helicopter pilots, both Arctic and Antarctic, have become disoriented, flown into the snow and been killed, or at least totally wrecked their "eggbeaters."

Glasses for Fliers

In 1957, while flying on instruments in an "average" whiteout, with only 10° of barely visible horizon ahead, the author accidentally discovered that yellow glasses with nickel coating increased the visiblity to an easily discerned 120° of horizon (yellow glasses or plastic goggles without nickel coating for reasons as yet unexplained do not exhibit this property). This finding was corroborated by three U.S. Air Force pilots. It was at the same time discovered that these glasses remarkably increased visibility of crevasses, sastrugi and nunatacks barely visible from the air.

Dr. Heinrich Rose, eye research man formerly with the U.S. Air Force, following work in Antarctica in 1957-58, pointed out that yellow glasses are good, but he believed red glasses to be better. Yellow is best, for with red glasses, (a) white and red cockpit lights become indistinguishable; (b) red lines and markings on maps become invisible; (c) red danger marks on instruments are invisible; (d) red trail flags, vehicles and red-dressed personnel on snowscape below become invisible; and (e) red glasses knock out peripheral rod vision on which most flying depth perception is based; while yellow glasses enhance rod vision to give almost phenomenal sense of altitude and attitude during landing and take-off from ice or snow runways.

The glare through 77 to 93% transmission yellow glass or plastic has prevented all but a few (Amundsen and Rymill) from ever using it. Nickel coating made it possible to reduce transmission to 15% and still preserve the virtues of the yellow filter. On DEEP FREEZE IV and again on DEEP FREEZE 60 (V), the glasses worn by all fliers when in control of aircraft are the Bausch and Lomb Kalichrome C, with Uniform plus Top Gradient Density "Inconel" metallic coating (the bottom density is omitted to make it easier to see instruments) in the "Outdoorsman" frame.

Glasses for Trail Personnel

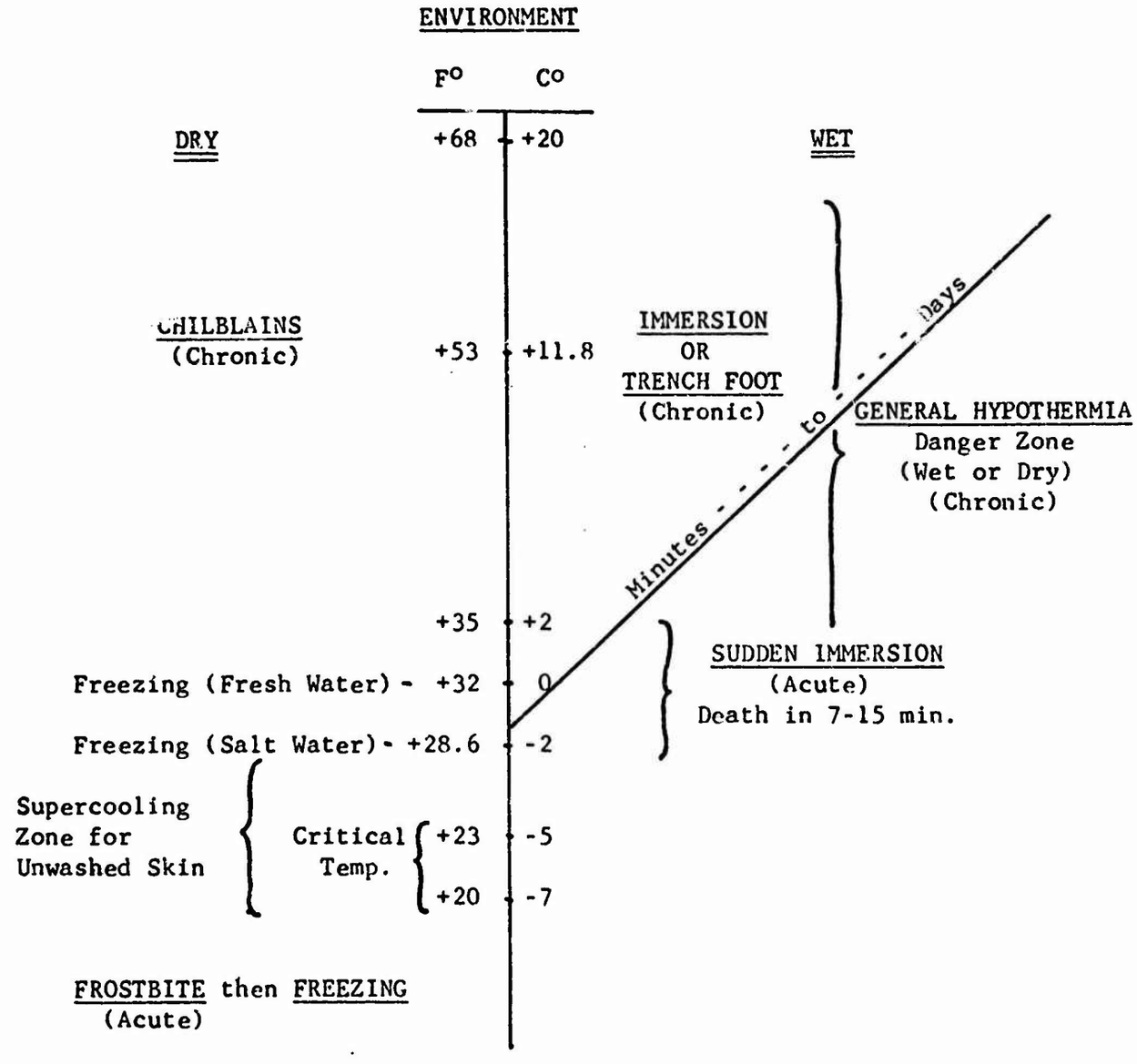
In 1958 not only were fliers routinely outfitted with both neutral gray glasses for ground use and yellow glasses for flying, but tractor train and trail parties were outfitted with gray and yellow glasses, (in the latter ease with double gradient density eoating to proteet them from snow glare).

LTCOL Merle R. Dawson, U.S. Army, for three years director of trail operations for Operation DEEP FREEZE, stated that the yellow glasses made it possible to operate "around the eloek" in erevassed areas when previously during average whiteouts it was neeessary, for safety, to be stopped 20 to 30% of the time. He also positively stated that the yellow-gray aged bamboo trail markers from the previous year's operations were visible half to onee again as far away with the yellow glass as with any other eye wear, in spite of the faet that the flags had often blown away in blizzards of the preceding winter.

Two frames, the "Outdoorsman" and the "Large Ray-ban," have the same lateral curvature and the same lens size and triangular shape. The "Ray-ban" frame has spatula or open "L" shaped ear bows (temples), which are easier to don and to remove while wearing balaelava or flying helmet, while the "Outdoorsman" has hooked ear bows whieh seeure the glasses better to the faee of those not wearing balaelava or helmet. The "Outdoorsman" frame has a brow bar to keep the metallic glass frame off the forehead, which bar also helps the frame to maintain the A-P curvature, and helps keep lenses in the frames during more or less rough usage. The ear bows are interehangeable at no differenee in priee and have been varied aceording to duties of personnel.

COLD INJURIES

In all cold weather injuries there are four physical variables. Temperature and moisture govern the type of lesion developed. Wind and length of exposure govern only the speed of development and severity. In discussing treatment, preventive measures not always obvious to the uninitiated are included, for as Dr. William Mills of Anchorage, Alaska, has said, "The best treatment of a frozen foot is its prevention."



Severity of all lesions is directly proportional to time, and inversely proportional to temperature of exposure (as modified by clothing).

CHILBLAINS

This mildest of dry cold weather injuries occurs most often in repeated prolonged exposure of bare skin at temperatures from the low 60's down to 32°F. (washed or most skin) to 20°F. (acclimated, dry, unwashed skin). Severity is proportional to temperature, humidity, wind, and frequency of exposure. It is common in the fashionably bare knees of British school boys. It accounts for the red "healthy" cheeks of South Island New Zealand children. Acutely, it is red, swollen, hot, more or less tender, and usually itches. Between periods of reactivation the skin is red, rough and cool under both cool and cold conditions. Normal vascular response to cold is said not to be lost. There is no loss of tissue in untreated cases.

Treatment: (1) Dress adequately to prevent continued exposure.
(2) Any bland soothing ointment for discomfort.

FROSTBITE (Superficial Frostbite)

In order to clarify the considerable confusion of terminology in the literature regarding frostbite, freezing, trench foot, etc., the author defines frostbite as a skin condition similar to sunburn, little deeper, and classified into two degrees of severity in the same manner; 1st degree - redness, followed by branny desquamation; and 2nd degree - blister formation in 24-36 hours followed by sheet desquamation. It is most common following brief exposures to extreme cold. Below 20°F., the ease of contraction depends directly on the wind chill factor (relation of wind to temperature), duration of exposure, and the adequacy of protection. Accompanying this condition per se, there is rarely a remarkable lowering of the general body temperature.

It is common on the face, hands and feet, being the most troublesome about the face. Its onset is signaled by a sudden blanching of the skin of nose, ear, or cheek, which may be subjectively noted by the experienced as a momentary tingling or "ping." Subjectively the face muscles won't work. Under severe conditions, the "Buddy System" of two men watching each other's faces for the telltale yellow-white spots will minimize tissue damage by early detection. In severe cold if your face, hands or feet STOP hurting, investigate—you probably have frostbite. When palpated, unthawed frostbit skin may be cold and frosty, crisp or resilient. It may move freely over bony prominences (joints, knuckles, facial bones.) Thawed superficial frostbite may be indistinguishable from deeper freezing injury.

Prevention of Frostbite

1. Face
   a. A moderately stiff four-to five-inch tunnel extending in front of the

facial aperture of the parka protects the face from wind at all but about 90 degrees dead ahead. This should contain a malleable wire at the outer aperture so that the opening may be shaped. With wolverine or wolf fur circling this outer aperture, difficulty with accumulating ice from breathing is minimized by frequent beating it out of the fur as it accumulates.

b. Face Mask. These are particularly needed by air crews who must occasionally work in the slipstream of aircraft turning up on the ground. A windproof pile-lined band, which will cover cheeks and tip of the nose only, is satisfactory under many conditions.

2. Hands

Windproof leather gloves or mittens are most satisfactory. Several types will be needed. (See CLOTHING.)

Particular care should be taken not to let the hands get wet with kerosene, gasoline, alcohol, or other fluids which freeze below 32°F., for these will cause quick frostbite and freezing. Touching of very cold bare metal with warm, moist bare hands results in the skin sticking to the metal, with resultant loss of tissue or quick frostbite.

3. Feet (See discussion of footwear under CLOTHING)

Foot gear MUST be roomy enough to permit easy movement of the toes, for continuous flexion and extension of the toes increase blood circulation and delay frostbite and freezing, particularly in the case of immobility of concomitant injury suffered in trail or plane operations.

To be particularly avoided are flying boots or galoshes which are worn over ordinary shoes. Frozen feet are the result of wearing these, because the inner laced shoe does not permit swelling concomitant with frostbite or shock.

Treatment of Superficial Frostbite

Clinically it has been proven that the quick thaw of freezing injuries in a water bath of 40°-43°C. (104°-108°F.) has a specific benefit on ultimate tissue recovery. Superficial frostbite is rarely seen where such treatment is available; however, it should be immediately treated whenever encountered, lest it progress to a freezing injury.

In the field, frostbite of the face is thawed by placing a warm hand over the spot until it hurts again. Frostbite of the fingers is best treated by wearing a parka with sufficiently large armholes that the arm may be withdrawn within the parka sleeve and the hand warmed under the opposing armpit. Thawing in this manner through the open front of a conventional coat allows rapid loss of vital body

core temperature. Frostbite of the feet is best thawed on the warm belly under the parka of a trailmate. (This is believed to be the height of brotherly love, and the hallmark of a true trailmate.) Warming of the heels, as well as numb toes of frostbit foot permits quicker thaw and less danger to the toes.

Chemical heating pads are good but are not always available and are never hot when needed. Placed on bare skin without the insulation of a blanket or towel, these pads may cause blistering burns, particularly on unconscious patients or those with frozen or anesthetized extremities. Petrol pocket warmers inside big survival mittens or parka pocket assure that the subject will always have a warm hand with which to thaw out face spots. Under NO conditions should frostbite be treated by rubbing, with or without snow or slush. When frostbite begins to peel, as does sunburn, any bland lanolin-base ointment will allay discomfort. (Though frozen tissues swell and blister, resembling frostbite or burns, they are NOT to be treated with ointment as are burns.)

FREEZING (Deep Frostbite)

When ice crystals form in tissues deep to the skin and its immediate subcutaneous tissues, an extremity is frozen. This is the third and fourth degree "frostbite" of literature. As "degrees" cannot be clinically distinguished before or during treatment, and as treatment is the same for all deep frostbite regardless of "degree" or duration, why quibble about degree? Freezing is always preceded by frostbite. It occurs most critically in the feet, occasionally in the hands and ears.

Unthawed it is painless, and tissues have a pallid yellowish color and appear somewhat translucent or waxy. Skin will not roll over bony prominences. Members may become quite solid or "wooden" to palpation, but never brittle. When brought indoors, the skin will collect droplets of moisture from the atmosphere just as a cocktail glass "sweats." Without rapid rewarming, blisters appear in 12-36 hours. Red-violet discoloration appears spontaneously on the first to fifth day. (This is not the slate-gray discoloration observed distal to arterial occlusion.) Termination without proper treatment is usually dry gangrene. Residual hypesthesias, paresthesias, and sensitivity to cold in recovered extremities are probably due to anoxic injury to the nerves from long, wet, cold exposure (trench foot) suffered prior to actual freezing. These seem to be more severe in frozen extremities which have not been rapidly rewarmed.

Prevention of Freezing

1. Prevent frostbite (above).

2. Maintain "core" or general body temperature with adequate clothing, nutrition, hot meals and hot fluids.

3. Avoid excesses of ALCOHOL in potentially freezing situations. It promotes excessive cooling from peripheral vasodilation (the subjective "warm" feeling), but more important its narcotic sleepiness and euphoria, causing loss of judgment, perception and ambition necessary to fight cold, contribute to freezing injuries and death from general hypothermia.

4. Avoid excessive fatigue, mental or physical, for like alcohol, fatigue causes neglect as well as lack of strength for proper preventive measures.

Treatment of Freezing Injuries

A. Field First Aid

1. Rewarm patient's core temperature. (Sec HYPOTHERMIA)

2. There must be NO constriction to circulation from boots or crampons above or over the frozen area. Immobilize concomitant fractures loosely without traction, for the snug bandages necessary for traction will further jeopardize circulation and increase freezing damage. For the same reason, avoid pneumatic splints.

3. Never THAW or rewarm a FROZEN extremity until arrival at a medical facility with water, heat, power and equipment for sterile bed care where extremities can be RAPIDLY rewarmed, for the following reasons:

a. Medical

(1) If thawed and REFROZEN, loss of digits and perhaps a hand or foot is the invariable outcome from gangrene, which occurs in four to seven days.

(2) Rapid rewarming is a specific therapy which minimizes ultimate tissue loss and sequellae. Rather than thaw in the field, it is preferable to keep an extremity frozen for four to eight hours more to enable rapid rewarming and immediate hospital care.

(3) The swollen, edematous, painful thawed extremity is more subject to infection during transportation than is the frozen extremity, and INFECTION is the chief reason for loss of tissue.

b. Logistic

(1) A man with a frozen extremity is NOT a stretcher case unless he suffers concomitant fracture or other serious injury. Under survival conditions, Freuchen walked miles and days for help, keeping his leg frozen, knowing that should it thaw he would be helpless.

(2) A stretcher case requires at least two men to carry him or pull him on an akja or toboggan.

(3) An ambulance, truck or helicopter will haul only four to six stretcher cases, but they will haul six to 24 men with one or more frozen extremities each.

5. NO ALCOHOL, vasodilating drugs, anticoagulants or friction.

B. Hospital Treatment

1. Rewarm patient's core temperature. (See HYPOTHERMIA)

2. Routinely and vigorously treat shock with elevation of feet, warmth, oxygen and intravenous blood plasma or fluid should they be necessary. These patients, particularly those with concomitant injuries, often go into profound shock on admission to hospital facility where it is warm.

3. If still frozen, rapidly rewarm in tub or water bath with pump or paddle, open-top washing machine, or whirlpool bath above body temperature but not "hot" to normal hand. Water at 102°F. is "warm" to a normal hand; 116°F. is as hot as the average person can stand continuously. A safe temperature seems to be midway between the two. Dr. Rudolph Campbell of Switzerland, Chairman, International Commission for Alpine Rescue, prefers increasing temperature from 50°F. over 30 minutes to a final 102-106°F. Mills and his associates in Alaska have successfully used 105-112°F. NEVER go over 115°F. or use dry heat, for this will superimpose a burn on the already insulted tissues. Thawing may take from 20 minutes to an hour, but it should be continued until all blueness or paleness of the digital tips has turned pink to burgundy red, and NO LONGER.

A large proportion of these cases have alcoholism as a predisposing or concomitant complication. Also, man, suddenly thrust into an extremely cold environment under survival conditions, through fear (often stark terror) often becomes psychotic. When he observes his pale, painless, frozen extremity turn burgundy-colored with more or less painful rapid rewarming, more fear is generated. These patients may require protective measures, tranquilizers or morphine for immediate thawing pain, and sometimes force to bring the first thawing to the proper end.

4. If already thawed, DON'T rewarm.

5. Tetanus booster on admission.

6. Physiotherapy

(a) Twice daily 1/2-hour whirlpool water bath (90°-98°F.) containing a mild detergent or soap until healing or spontaneous amputation takes place.

(b) Immediate ACTIVE JOINT MOTION, particularly during hydrotherapy. This usually requires supervision and encouragement to overcome patient's pain, laziness, and/or apathy.

(c) Buerger's exercises 20-30 minutes every four hours during day.
(1) Patient supine, legs elevated at 30° angle - 2 minutes.
(2) Patient sits on edge of bed, feet dangling.
a. Flexes and extends ankle
b. Rotates lower leg
c. Spreads and closes toes
} slowly and deliberately 3 minutes
(3) Patient flat in bed with legs under blanket - 5 minutes.
(4) Repeat above cycle three to six times per session.

7. Surgical Care

(a) For the first two to three weeks until the skin is dry and without blebs or lymph drainage, ALL attendants MUST use sterile isolation technique with masks, gowns, gloves, bedsheets, etc. to minimize infection. Treatment of elevated member under cradle is open without dressings, bandage or ointment. Sterile cotton between toes minimizes maceration.

(b) Blisters invariably complicate freezing injuries. Early and clear blisters, particularly down to the tips of digits, are a good sign. Higher blisters, and particularly blood-filled blisters are an ominous sign that perhaps a digit will be lost. Leave all unbroken blebs alone. For the first two to three weeks, debridement is limited strictly to trimming gross skin flaps loosened by the daily hydrotherapy. When the wound is dry and uninfected, constricting digital eschars interfering with joint flexion may be slit laterally or dorsally. Trust the whirlpool to atraumatically and aseptically clean up local infection and to debride blisters and eschars.

(c) NO AMPUTATION FOR AT LEAST THREE MONTHS or until after autogeneous (spontaneous) amputation, unless there is overwhelming infection or concurrent injury which requires it! This will minimize tissue loss and ultimately reduce hospital time by giving healthier tissue for such repairs or skin grafts as may be necessary. Color of skin or amount of skin loss below the line of demarkation is NOT indicative of end result. Skin can always be replaced; a prematurely amputated digit, hand, foot or leg CANNOT!!!

(d) Split thickness or pedicle skin grafts when denuded granulating areas are ready.

(e) Sympathectomy. Recovered dry frozen members are usually relatively painless, though they often have intrinsic muscle and fat pad atrophy. After six months, if disabling wet cold sequellae are improved by sympathetic block, sympathectomy should be performed.

8. Broad spectrum antibiotics are administered ONLY with evidence of deep infection or cellulitis.

9. Psychiatric Measures. Opiates should be avoided after initial thawing because these cases are prone to addiction. During the first three months, pleasant environment, frequent visits, encouragement and occupational therapy are mandatory. Depressed patients often talk surgeons into amputation because of depression over black foot or finger. Tranquilizers, alcohol, barbituates and/or dextroamphetamine may be indicated during this period. (The physician often needs this therapy himself during this period, for his urge to do something surgical makes him the patient's and his own worst enemy.)

10. Ascorbic acid ..... 50 mgm q4th
Hesperidine (or Rutin)..... 50 mgm q4th
Nicotinic acid ..... 50 mgm q4th
Vitamin E (Alpha-tocopherol) ..... 30 mgm daily
Vitamin A ..... 25,000-50,000 units daily

11. High caloric, high protein diet.

12. The most promising new therapy for freezing injuries is IV administration within an hour after admission of 1-1/2 gms/kgm body weight of 10% low-molecular weight (41,000) dextran in normal saline, repeated BID for the first five days. This must be given very slowly to prevent overloading the heart. It is reported that in northern Sweden the LMD dosage is routine 500 cc/day for the first eight days.

13. Smoking is discouraged.

14. NO anticoagulants, NO vasodilating drugs, NO high-intensity sound therapy.

IMMERSION FOOT (Trench Foot or Bomb Shelter Foot)

This results from wet cooling for hours or days of an extremity or portion thereof at temperatures above freezing. Dependency and/or immobility of the extremity aggravates and predisposes. Sailors in sea water or soldiers with wet feet in trench or foxhole get the same condition. Nerve, muscle and blood vessel injury due to cooling is the common feature. General body chilling and venous stasis are certainly etiological factors.

On first examination in the stage of ischemia, the foot is cold, swollen, waxy and mottled with cyanotic burgundy to blue splotches. It is resilient to palpation in contradistinction to the fresh frozen foot. Walking is difficult, for the skin is anesthetic, and deep musculo-skeletal sensation is usually lost.

The first stage is followed by the hyperemic phase, which lasts days to weeks. The feet are red, swollen and hot; blisters often form. Throbbing pain and burning sensation plague the patient. "Recovered" immersion feet often have edema, deep stabbing pain, superficial burning, cold sensitivity, hyperhydrosis, and greater or lesser muscle weakness, paralysis, and atropy. The best-treated

cases often result in gangrene. Disability may be months or years.

Treatment

Differs from the treatment for frostbite in the following particulars:

1. No rapid rewarm.
2. Hydrotherapy is used only for blebs, ulcers or infection.
3. Drugs for relief of pain are more often necessary, but should be used minimally and discontinued as soon as possible.
4. Vasodilation and circulation should be assisted within hours by:

a. Sympathectomy
b. Heparinization, maintained until feet have "normal" vascular response and are relatively painless.
c. Regular administration of alcohol, one ounce of hard liquor every hour, may help circulation. (This therapy has also been known to cure this socially popular narcotic habit!)

5. Massive vitamin B complex therapy is certainly indicated. In a military environment like Korea where daytime temperatures were in the 40's F. and nights were below freezing, OR in uniform sub-freezing temperatures where men wear watertight, thermal boots and their feet are continually bathed in their own perspiration, injuries are usually mixtures of both wet and dry cold. It is suspected that an immersion foot may have also been frozen once, therapy directed toward the immersion foot regime will probably produce the best end results.

GENERAL HYPOTHERMIA (Chronic)

As an internal combustion engine, man burns fuel in the muscles to produce work and heat, but a core temperature of at least 95°F. is necessary to maintain the process. Diminished oxygen, food, faulty circulation, poor condition, narcosis and/or fatigue diminish the fire.

At environmental temperatures less than 68-70°F., man's survival depends upon insulation (body fat, clothing), ratio of body surface to volume, the body fire (basic metabolic rate), and the will to survive. Below 95°F., hypothermia produces diminished BMR, heart rate, blood pressure and uncontrollable shivering. Hallucinations, apathy and narcosis occur at 86-80°F., death from ventricular fibrillation or cardiac arrest at 80-75°F.

Freezing to death in dry cold is a very pleasant way to go. Those who have come close describe the symptoms as extreme fatigue (only the fatigued sleep through the violent shivering), weak muscles, joint stiffness, and ultimately a feeling of warmth, comfort and an overpowering sleepiness. Unconsciousness and death follow painlessly.

Treatment

See IMMERSION HYPOTHERMIA below

IMMERSION HYPOTHERMIA (Acute)

Sea water freezes at 28-29°F. It may be assumed that most polar water with ice nearby is this cold. Man submerged in this water, depending on amounts and type of clothing worn, has his breath knocked out, there is initial shivering and then the body goes into a position of spastic foetal flexion with hands and knees under the chin, and voluntary control of the muscles is lost. (The ungloved hand is useless in one to five minutes.)

In water the body core temperature falls very rapidly. On first submersion there is reflex contraction of the arterioles to save temperature. This gives fleeting increase in blood pressure and heart rate. Consciousness lasts 5-7 minutes, death occurs in 10-20 minutes.

Cold shock causes strychnine-like electroencephalographic patterns, and therefore probably should not be treated with stimulants. Exposure of the back of the head and neck was found to cause cerebral hemorrhage and death at Dachau, so this part of the anatomy should be particularly protected. Loss of breathing and necessity for artificial respiration is due to spasticity of the muscles of respiration.

In a few instances, men have saved themselves by violent exertion as soon as they hit the water, were able to swin some distance and pull themselves out on the ice or up a ladder. More have died or would have without help because of muscle spasm.

In water at 41°F. for 12 minutes, it has been found that moderate work doubled the rate at which rectal temperature fell, because of increased blood circulation. Working as hard as possible only slightly decreased the rate of temperature loss at this temperature. If in a marine disaster at temperatures not causing the above acute reaction, exert yourself as little as possible--you'll live longer. In water at 59°F., clothing reduces loss of temperature by three-fourths. The obese have been found to be better insulated from loss of temperature (and slower to rewarm), responding in direct proportion to the thickness of their subcutaneous fat.

With a large number of cases, as in ship-wreck, treat those not breathing (but alive) and the unconscious first. Pouring water at 110-116°F. over those waiting for treatment will increase the number of survivors, for after removal from the water (without treatment) a paradoxical "after drop" in temperature, caused by vasodilation with rapid cooling of the core from the cold "shell" tissues, will kill many who seem safe.

Treatment for Immersion or General Hypothermia

1. Unconscious, not breathing.

a. Artificial respiration, with oxygen if available, keeping patient as warm as possible with hot water bottles, warm wet packs, etc. Methods to be used in order of preference are:

(1) Mouth-to-mouth: blow air into subject--an assistant may alternately express air by chest compression. If drowning is evident (regurgitation of stomach water), change position of patient from supine to prone and use (2) or (2) and (4) simultaneously, if two operators are available. (This method has been proven remarkably efficacious with two 60 to 80-lb. Boy Scouts working simultaneously on a 200-lb. male subject.)

(2) Holger-Neilson, if no assistant available. (Prone; back pressure, arm lift.)

(3) Sylvester (if and when stomach emptied.) (Supine; chest pressure, arm spread.)

(4) Schaffer prone pressure with alternating hip lift or hip roll to assist inspiration. (Prone; floating-rib pressure.)

b. If in ventricular fibrillation (and still alive) electrically defibrillate or give "Pronestyl" (procaine amide), said to be more effective in this acidotic condition than is quinidine. Fibrillation may continue for 1-1/2 to 2 hours after body temperature has returned to normal.

c. In General (Chronic) Hypothermia, dehydration is often acute and IV glucose and/or dextran are indicated to expand blood volume and support metabolism.

2. Unconscious, breathing:

a. Place in a tub or shower with water 110-116°F. and keep there until rectal temperature is above 95°F. or the patient has quit shivering.

b. Put in warm sleeping bag with heating pads, hot rocks, etc.

3. Conscious

a. Put in a tub or shower with water at 110-116°F. and leave there until subject quits shivering.

b. When rectal temperature is above 95°F., two ounces of brandy or whiskey in a hot drink promotes quicker warming and a sense of well-being.

"FROSTBITE" OF LUNGS

During hyperventilation following strenuous exercise at temperatures below -25°F., particularly at high altitude (e.g., South Pole: seismologically 9,200 ft., barometrically 10,000 ft.; physiologically 14,000 ft.), man coughs up blood from the trachcobronchial tree. This is not a "frostbite," as there is no freezing of tissue. Marked respiratory mucosal hyperemia (as in flash burn) causes this expectoration of frank blood. Concurrent or as an aftermath, asthmatic-type breathing may occur for periods of hours to a day or two, depending on the severity of exposure, altitude, and the man. It can be prevented to some extent on trail by slowing down and by utilization of parka hoods, face masks, folded mufflers, etc., which enhance rebreathing of some warmed, humidified, expired air. There is no immunity for the condition. Treatment is symptomatic. Humidify quarters to 30% bed rest, steam inhalations, and NO SMOKING until breathing difficulty, hemoptysis and cough subside.

CARBON MONOXIDE POISONING

Carbon monoxide is a heavy, odorless, colorless, tasteless, asphyxiant gas resulting from the incomplete combustion of fuels; e.g., coal, wood, and other hydrocarbon fuels. Use of petroleum products in internal combustion engines and stoves makes poisoning common in modern Polar activity.

Carbon monoxide kills through asphyxia even in the presence of adequate oxygen, because oxygen-transporting red blood cell hemoglobin has a 210-times greater affinity for carbon monoxide than for oxygen. Rate of absorption is increased with carbon monoxide concentration, with rate and depth of breathing, increased activity or altitude, time of exposure, blood concentration (polar dehydration), temperature, humidity, and decrease in percentage of oxygen inspired.

At sea level, ordinarily carbon monoxide blood saturation up to 10% causes no symptoms (heavy smokers run up to about 8%). Headaches, dimmed vision, dizziness, nausea, exhilaration or lassitude, muscle pain or weakness, or chest pain may or may not give subjective warning before collapse, unconsciousness and death, which may be quite rapid.

Treatment

1. Preventive

a. At all times assure adequate ventilation in buildings, shelters, vehicles and aircraft when running engines or when cooking over open-flame stoves.

b. Don't use unvented engines or heaters or those with defective exhaust systems.

c. Turn off heaters during hours of sleep unless:

(1) There is a frequent roving fire watch, or

(2) Carbon monoxide alarms are frequently tested and completely maintained.

d. Pay attention to odors associated with engine exhaust and immediately ventilate or stop the engine. If airborn, set diluter demand valves on 100% OXYGEN position and don't remove your face mask until the leak is discovered and stopped or until the flight has terminated.

e. In helicopters, avoid hovering when engine exhausts are to windward.

f. In survival tent, igloo, or snow hole on the trail:

(1) Assure active ventilation in spite of heat loss to incoming cold air.

(2) Leaded gasoline burned in stoves produces lead oxides which are irritating but non-toxic in small amounts. Smarting eyes, running nose, or cough produced by these give warning of carbon monoxide buildup.

2. Definitive

a. Move subject into fresh air at once.

b. Artificial respiration if necessary.

c. Give 100% oxygen (with 6-7% carbon dioxide to stimulate hyperventilation).

d. Keep warm and quiet in bed or sleeping bag for at least eight hours. About half the carbon monoxide in the blood will be eliminated the first hour, breathing air (20% oxygen). Too early exertion may produce heart failure.

ANOXIA

When cabin, igloo, tent, or building is poorly ventilated and sufficiently airtight, there doesn't have to be a fire for man to die, although a fire will accelerate the process. Complete combustion, whether in man or in a fire, results in intake of oxygen and output of carbon dioxide.

When the percentage of oxygen goes down from roughly 20% of the room air, and the carbon dioxide climbs from a little less than 1%, man breathes deeper to better aerate. (If carbon monoxide is also present, he will die more rapidly.) When the partial pressure of oxygen sinks from 157 mm of mercury (sea level) to 30 mm, the average active healthy man becomes unconscious, and shortly thereafter dies. This process is naturally more vicious and more quickly produced at altitude where the partial pressure of oxygen is reduced.

A candle's burning depends on oxygen percentage and not on oxygen tension. It dims and then goes out when the oxygen percentage drops from 20% to 16-17%, and long before man is affected by anoxia (but not carbon monoxide). This makes observation of a burning candle a must in a tightly-closed polar shelter, and it will help heat a proper igloo as well.

FIRST AID IN COLD CLIMATE

In polar regions the injured go more quickly into shock and go into a more profound shock than in more temperate areas. Hypothermia and freezing injuries are enhanced; hence, all efforts should be made to treat shock and quickly transport the injured to warm hospital spaces. Treat all painful or disabling injuries as though complicated by shock.

1. Keep patient warm in a double sleeping bag, using chemical heating pads. (Water to activate these pads must be kept warm in a thermos bottle.)

2. Place head slightly lower than the feet unless skull fracture is suspected.

3. Give 1/4 to 1/2 grain of morphine for painful injuries, such as fracture or burn, unless the patient is unconscious from possible skull fracture. (Syrettes must be carried in an inside pocket of doctors, leaders, aid men, etc., to prevent freezing.)

4. Administer oxygen routinely if available.

5. Transport as quickly and as safely as possible by helicopter, bush plane, Sno-cat ambulance, akja or dog sled to a heated wannigan, building or ship where blood or blood substitutes can be administered. Don't give spirits until in permanent heated camp and patient has normal blood pressure, and not then for 8 to 12 hours if patient has suffered a freezing injury.

6. The man unconscious or in shock on the trail requires extra heat to the extremities, particularly the feet, to prevent frostbite and freezing injury. NEVER assume feet will stay warm because he has "adequate" footwear. His feet may have been at the point of frostbite at the time of injury. ALWAYS investigate the feet, change to dry socks, and use heating pad or other form of additional heat even IF THE FEET ARE NOT FROZEN. (See treatment of freezing injuries, p. 70.)

7. If station doctors make up first aid kits or are given itemized lists of kits carried by all trail parties, more accurate and expeditious advice may be given by radio communication in case of emergency on the trail.

8. The classic signs of fracture are pain, swelling, and POINT TENDERNESS. The patient may or may not have heard a SNAP; he may or may not be reluctant to use the member; and there may or may not be deformity with attendant muscle spasm. POINT TENDERNESS means that there will be ONE SPECIFIC POINT which gives excruciating pain when GENTLY pressed. A second nice test for fracture is to GENTLY tap the member in the longitudinal axis of the bone suspected of fracture. This produces mild but sharp pain; e.g., for suspected ankle fracture, tap heel GENTLY on the bottom toward the knee. Or for suspected finger or

hand fracture, tap GENTLY on the tip of the suspected finger toward the wrist. SPLINT ALL FRACTURES. SPLINT ALL DISLOCATIONS. SPLINT ALL SEVERE sprains. In any case, splint over clothing, as loosely as will immobilize, and avoid skin-metal contacts.

9. NEVER splint fractures in sub-zero temperatures with recently perfected "atraumatic" pneumatic splints which surround the arm or leg.

a. The constriction necessary for immobilization enhances freezing injury.

b. Transportation by air causes increased pressure and gangrenous embarrassment of circulation unless pressure is reduced on ascent. Descent will reduce pressure and immobilization is lost unless steadily re-inflated.

10. Treat wounds through holes in clothing to minimize general hypothermia and shock-producing trauma.

11. Painful first or second degree burns and frostbite blisters on nose, cheek or ears may be nicely dried and anesthetized with a 70% alcohol wet pack, although as the "Wahoo Bird" said, "Wow, what a sensation!"

12. Cuts and abrasions on men living in camps heal quickly providing they keep up their Vitamin C, and the wound is kept clean and properly cared for.

On the trail, or for men out in the cold a great deal, wound healing may be slower during the early stage of healing, but almost overnight after a few days of proper care the formerly open wound will heal. Total time is about the same in either case.

INDIVIDUAL FIRST AID KIT

5 yds. 1"-2" adhesive (plastic)	6 Analgesic Capsules*
6 sterile pads (4")	12 ASA (aspirin) tabs. 5 gr.
1 roll 3" Ace (elastic) bandage	3 tabs/day Fresh Halozone Tablets (except Antarctica)
1 roll 1" gauze bandage	12 tabs Gantricillin (Roche)
Assorted "Band-Aids"	12 Amphetamine Sulfate (see p. 70)
1 - 36" square muslin bandage	1 two-ounce Tr. Merthiolate
1 bar (hotel) Ivory Soap	

*Analgesic Capsules (may be obtained only on following prescription)

Each capsule:

Charcoal ..... gr 1/2	Gray color permits accurate mix
Atropine ..... gr 1/150	Relaxant and thirst-producer
Papaverine ..... gr 1/50	Smooth muscle relaxant
Codeine ..... gr 1/2	Relieves aches and pains
Pyribenzamine ..... 50 mgm	Antihistaminic
Acetylsalicylic Acid .... (aspirin)	qs ad. gr X

Mft. T. D. No. _____, mixing atropinc thoroughly with the charcoal, adding papaverine and thoroughly mixing, add codcinc and mix, etc., so that final even gray mixture precludes any one capsule having an overdosage of one of the more potent constituents.

(This analgesic capsule will not cure the "common cold," la grippe, virus pneumonia, "flu" or allied acute upper-respiratory infections, but it will certainly make the patient enjoy the disease more.)

BASIC MEDICAL SUPPLIES FOR SMALL MOBILE POLAR EXPEDITION

Here is furnished the list of medical supplies and equipment for a 16-man polar expedition for six months. Personnel would all be trained in advanced first aid. Key personnel must be taught such definitive medical procedures as, e.g., how to remove a superficial foreign body from the front of the cornea and how to clean and sew up, clip or tape-close a common laceration. Evacuation to definitive medical care would be available on a few hours' notice. In any case a "Master's Manual," whereby for years lay mariners have successfully treated medical cases, is a handy item to have in the kit.

Recommended: "The Ship's Medicine Chest and First Aid at Sea," by U. S. Public Health Service and War Shipping Administration, rev. 1955 (U. S. Government Printing Office).

	Main Station Number	Trail Party	Remarks
Morphine Syrette 1/2 grain	6+	1-2 per man to be carried in crush-proof or wearproof metal or plastic container, in inside shirt pocket.	These can best be obtained from the Medical Officer at your last military station.
Codeine Sulphate 1/2 grain	100	8 tabs per kit	For relief of pain.
Acetylsalicylic Acid 5 grains	1000	24 per kit	Aspirin for head or joint aches.
Tripelannamine (Pyribenzamine) tabs., 50 mgm.	100	24 per kit	Antihistaminic vs. swollen mucous membrane, one every 3 to 4 hours.

	Main Station Number	Trail Party	Remarks
Erythromyein 50 per bottle	4	1 bottle per kit	3 to 5 tablets every six hours for infection or pneumonia and for those allergic to penicillin.
Maxipen (Pfeizer - Roerig) or Synsillin (Bristol) 250 mgm. (Synthetic Penicillin, 400,000 units each oral, and less allergenic than penicillin)	100 tablets	10 per kit	One tablet every six hours between meals for HIGH fever which must NOT be due to dehydration. If man breaks out with itching "hives" or develops asthmatic breathing (in easy, out hard) discontinue immediately and put on Erythromycin.
Dehydrocholic Acid (Decholin) 4 gr.	100+	15 per kit	1 to 2 tablets 2 to 3 times per day if indigestion follows first day or two or trail diet.
Brandy 1/5/man?/month?		1/5 gal. per kit	
Zinc oxide ointment 2 oz. tubes	6	1 per kit	To protect nose from from sunburn
Elixir of terpin hydrate with codeine	16 oz.	2-4 oz. per kit	For nagging cough 1 to teaspoonsful at bedtime
Codliver oil-(50-50) Vaseline Ointment	1 lb.	2 oz. per kit	Best burn ointment known. Need not be sterilized for cod liver oil is bacteriostatic
Chapstick or Menthlatum 1 oz. tube	18	1 per man	Prevention and treatment of dry skin and sunburn

	Main Station Number	Trail Party	Remarks
Nupercaine Ointment 1% - 2-4 oz. tube	6	1 per kit	For hemorrhoids, painful burn, chafing, etc.
B.F.I. (Bismuth, Formic Iodide) 1 oz. cans	6	1 per kit	Ideal for chafing between legs, advanced athlete's foot.
Desenex Powder - 2 oz.	6	1 per kit	For athlete's foot
Ascorbic Acid (Vitamin C) 50 mgm	200	20 per kit	100 mgm of each of these every four hours is ideal treatment for Polar sore throat. The hot feeling or momentary nausea may follow this dosage, but no one is ever hurt by this "hot flash," in fact, it seems desirable.
Nicotinic Acid (Vitamin B_2) - 50 mgm	200	20 per kit	
Bismuth and Paregoric (32 oz.)		6 oz. per kit	For diarrhea, 1 tablespoon after each BM until BM's 2-1/day.
Amphetamine Sulfate (Benzedrine) 10 mgm preferred over Dextro-amphetamine Sulfate (Dexedrine) 5 mgm	100	6 per man	Put in 1 oz. tin with cotton to keep tabs from breaking. These are for emergency when a man is POOPED, but must carry on for 8 to 12 hours longer without sleep. They should be a personal item in case gear might be lost.
Hexachlorophene 5 oz. squeeze bottle Bar of Ivory Soap	3	1 per kit	For cleaning wounds with COPIOUS washing.
Merthiolate (Tincture)	32 oz.	2 oz. per kit	Wound disinfectant. AFTER cleansing with soap or pHisoHex.

	Main Station Number	Trail Party	Remarks
Ophthalmic:			These may be combined in treatment
a. Cortizone eye ointment 1 oz.	6	1 per kit	For red eye without pus.
b. Butyn eye ointment, 1 oz.	6	1 per kit	For painful eye, but dressing must be worn at least 8 hrs. after last administration.
c. Sodium sulfacetemide ointment, 10% - 1 oz.	2	1 per kit	For red eye WITH pus.
d. "Flour-i-strip" (Doho Chem. Co. fluorescein paper)	12	2 per kit	Use as directed to stain corneal abrasion or foreign body.
Sodium amytal, 200 mg.	100	6 per kit	For sleep of INJURED or mentally disturbed.
Meprobamate (Miltown), 400 mgm.	100	12 per kit	For anxiety of INJURED man or mentally disturbed.
Epsom Salts	5 to 15 lbs.		1 lb. per qt. hot water for hot applications to infected wound or abscess (solution can be reused if necessary)
Bandages:			
a. 4 x 4 gauze pads	100	6 per kit	
b. Bandaids	200	25 per kit	
c. 1" Roller band.	1 doz.	1 per kit	
d. 2" Roller band.	1 doz.	1 per kit	
e. Eye pads	2 doz.	6 per kit	
f. Triangular band.	1 doz.	3 per kit	Makes good tourniquet
g. 2" Adhesive tape	1 doz.	1 per kit	
h. 3" ACE elastic bandage	1 doz.	2 per kit	
i. 1/4 lbs. cotton	6	1 per kit	
j. Applicators (swabs)	1000	10 per kit	

Arctic Only

a. Mosquito repellant - 1/2 ounce per man per day.

b. Halozone tablets - 3 per man per day for water purification. 1 tab/qt water gives potable safe water in 30 minutes. One "Bursalina" iodine tab/qt water makes it safe in 15 minutes.

	Main Station Number	Trail Party	Remarks
Equipment:			
a. 2 oz. bottles	2 doz.		For pills, merthiolate, etc., for trail kits
b. 1 oz. tins	1 doz.		For dispensing and for trail kit pills (with cotton pad)
c. 2 oz. tins	1 doz.		
d. Chemical hot water bottle	6	If used on trail crash line, etc. should have 1 qt. "Thermos" full of HOT water to activate chemical.	For shock treatment in all severe cases.
f. Bandage scissors (6")	2		
g. Straight scissors	2	1 per kit	
h. Tweezers	2	1 per kit	
i. Eye spud	1		
j. Triangle tip metal applicator	1		
k. Kelly haemostats, straight	2		
l. "Walk around" oxygen bottle (Navy or Air Force) with face mask and extra bottle	1		Treatment of carbon monoxide, poisoning, freezing, injury, shock, etc.
m. Molded plywood utilitarian splint	2		Can be used for immobilization and/or traction of fracture of arm or leg. They are light, handier than the Thomas ring splint and should be cheaper. They do not have to be so carefully padded as the Thomas splint to keep patient comfortable.
n. Box of tongue blades	1000	6 per kit	These have "1000 and 1" uses--finger splints, tongue depressors, coffee stirrers, etc.
o. Roll of wire gauze splint, 3 ft.	2		Invaluable in arm and wrist fractures

	Main Station Number	Trail Party	Remarks
p. "Combistix" reagent strips (Ames Co., Inc. Elkhart, Indiana)	5 strips/man		Test for urinary protein, glucose, and pH.
q. Oil of cloves	6 oz.	1 oz. per kit	For toothaches.
r. Skin pencil	2	1 per kit	For marking skin.

Empirin contains a benzamine ring compound which is hard on the white blood cells. APC contains the same and in addition causes excessive sweating. In some people these are dangerous, and the desired effects are not better than with acetylsalicylic acid (identical to "Aspirin" but much cheaper).

Lobar pneumonia is practically unknown in polar areas, so don't worry about it.

Ammonia inhalants are useless weight. Lay them down and they won't faint.

Syringes were left out because with oral penicillin (safer from an allergic standpoint), there is nothing to inject.

Laxatives are definitely NOT needed. Constipation, hemorrhoids, etc. may be prevented and treated by copious drinking of water. MOST fevers are likewise caused by dehydration.

Give one morphine syrette no oftener than every six hours, or 1/2 syrette every four hours, for severe fracture, burn, etc., which cause pain, which in turn causes shock. Accurate records of dosage and time MUST be kept to prevent excited, though well-intentioned assistants from killing the patient with more morphine. Mark dosage and time with skin pencil on forehead IMMEDIATELY after injection.

Petrolatum gauze can be made with the cod liver oil-vaseline ointment and 4x4's for any occasion when this is needed. This saves space and handling a messy item.

Wound healing and healing of fractures is as fast in cold climates as it is anywhere else. Rumors to the contrary have arisen because men who work considerably bare-handed in the cold develop thick dry skin on the fingers which cracks easily, and on repeated exposure these cracks do not heal well. A day or two inside with application of lanolin or cod liver oil-vaseline and these cracks readily heal.

Need for Vitamin C is increased in the cold, and because of its work in wound healing, Vitamin C supplement should always be given to assure proper healing. (See also FIRST AID, p. 79.)

DENTAL CARE

Prior to the first Byrd Antarctic expedition in 1928, all 75 men had their teeth cleaned, thoroughly examined and charted, x-rayed, history of food habits and oral hygiene noted, conditions of the soft tissues and oral infection were noted, and tooth mobility tested. These men required the full time of a dental team every weekday and many nights for two months to accomplish 321 fillings (one man required 22), 66 extractions (many impactions), 6 partial and one full upper prosthesis. Instructions were given on oral hygiene before and during the expedition.

Two years later the same dentist examined these men, finding 28 men had no cavities, 31 men had 42 new cavities, 2 teeth were broken, and four old fillings not serviced in 1928 had broken. No man who had wintered in Antarctica had appreciable calculus--all smokers' teeth were stained.

This points out that mouths with exacting and complete dental care, and stressing of oral hygiene (even before fluoridation of water supplies and toothpaste), prevented remarkable difficulties in a two-year period, 15 months of which time was spent on the ice. (Diet factors are covered in NUTRITION and TRAIL RATIONS.)

Anterior silicate fillings do better in the cold than gold inlays. Fillings with insulated bases rarely are temperature sensitive. All fillings over two to three years old should be replaced for first-class pre-expedition dental workup, for new amalgams do not retract in the cold as has been previously reported. Devitalized teeth, particularly in the presence of oral infection, hurt in the cold. (They probably should be removed anyway to prevent abscess formation in any climate.)

PREVENTIVE

Lay readers, knowing that the following pages are intended for MD's or scientists who must work on their fellows in emergency, may be very interested in delaying or preventing dental troubles.

1. Ideally, brush tooth away from the gums, after each meal. Practically on the trail at least once daily after the big meal. Use dental floss with a knot tied midway to remove food from between teeth.

2. Use fluoride toothpaste, soda, or just water, but brush!

3. Don't eat candy or sticky sweets (e.g., fruit cake bars!)

DENTAL EMERGENCIES

Equipment. Dental mirror, probe, pair of tweezers, excavators, filling instruments (mixing spatula and paste tamper), extracting forceps, hypodermic syringe, cement mixing papers or slab and air syringe.

Supplies. Zinc oxide, oil of cloves, 2% lidocaine, 1:1000 epinephrine, absorbable hemostatic gauze, codeine, hydrogen peroxide, amyl acetate, acetone, phenol, alcohol, iodiform gauze, dental floss, sandpaper, formalin solution, fluoride paste (10 gm Kaolin, 10 gm NaF, 10 cc glycerine), "Sansidine" paste (Block Drug Co., 105 Academy Street, Jersey City, N.J. - strontium is active ingredient).

TOOTHACHE

Transient toothache to temperature or sweet stimulus often means exposed dentine in cavity or at tooth neck where gums have receded (usually due to lack of brushing). Probe for any cavities or sensitive spots. Fill cavities or paint tender tooth necks with formalin solution with fluoride paste or strontium paste.

Continuous dull ache or throbbing pain is usually due to pulpitis from cavity with or without alveolar abscess and gum redness. Percuss and test for looseness. (Sinus pain is similar, but in several upper teeth without dental cause.) Excavation of cavity and filling with zinc oxide moistened with oil of cloves may relieve. If pain is not relieved, if tooth is tender to percussion, or if there is gum swelling, give 300,000-500,000 U of penicillin or comparable wide-spectrum antibiotic and pull tooth. Two exceptions are abscesses which have spread to the orbit (may cause cavernous sinus thrombosis) and those which spread sublingually, giving Ludwig's angina, cellulitis of the neck, and/or edema of the glottis. These are treated with heroic doses of antibiotics, pus is evacuated by intraoral incision if possible, and the tooth is not extracted until infection has completely subsided and the patient is afebrile.

Fillings

Comfortable temporary zinc oxide-eugenol (oil of cloves) paste fillings harden in 10-20 minutes. (Have patient bite down before the filling sets to simplify occlusion problems.) If they erode, they may be refilled with zinc oxide-cloves, or replaced by leucite or other plastic, made pliable with acetone, forced into the cleaned, scraped, washed, dried, disinfected (with phenol followed by alcohol) cavity, and trimmed to give comfortable occlusion.

Loose Fillings

These do no good. Remove; clean, debride, wash and dry socket; fill with temporary filling.

Ulceration

Sores of mouth or gum may be due to:

(a) Lack of oral hygiene (brushing)

(b) Eating of snow (or mouth breathing in extreme cold)

(c) Avitaminosis C and/or avitaminosis B_2

(d) Vincent's infection (trench mouth). This infection is occasioned by poor oral hygiene and avitaminosis C, lowering natural resistance to two symbiotic organisms found normally in mouths, allowing their proliferation or massive increase in numbers of organisms by contagion from a grossly infected case. Gray ulcers which bleed easily appear at tooth gum margins (and sometimes on the tonsils). Positive diagnosis is made with stained microscopic smear. Treatment is:

(1) thorough cleaning with hydrogen peroxide

(2) painting of ulcers with potassium dichromate or chromic acid (both 7% solutions)

(3) arsenical mouthwash and gargles

(4) Penicillin chewing gum or lozenges

(5) eating of 6-12 oranges per day (300-600 U of Vitamin C)

The above should produce a cure in 2-4 days. Prevention is easy with oral hygiene, good mess sanitation and daily vitamin supplementation.

(e) Herpetic stomatitis (cold sores, canker sores). One or more gray ulcers with red halos. Treatment is:

(1) vaccinate with cowpox daily for three days.

(2) soda (1 tsp/glass) mouth wash three times a day.

(3) paint larger tender lesions with 2% iodine or touch with silver nitrate (after drying) then eugenol.

Pericoronitis

This is inflammation of gum tissue around the crown of erupting teeth. Because wisdom teeth are the only usual late eruptors, and because removal of these is a job for a GOOD ORAL SURGEON, why not have these removed at home before the expedition if x-rays show them unerupted, and particularly if they are impacted?

Treatment of infected skin flaps over erupting teeth is by nicely draining with careful skin incision and insertion of iodoform gauze followed by maintenance of oral hygiene and hot mouth washes. Medical officers should NOT attempt extraction of these teeth.

Fractured Tooth

If painful, dry the exposed surface, paint with formalin or with fluoride paste, or fill exposed pulp space with zinc oxide paste. Smooth sharp edges with sandpaper. If results are not painless the tooth will have to be extracted.

(For details on tooth extraction and treatment of fractured jaws, physicians should read the excellent brief treatise "Emergencies in General Practice; Dentistry for the Ship Surgeon" by E. Joseph, F.D.S., British Medical Journal, March 24, 1956, pp. 679-681.)

Bleeding Socket

After extraction, have patient firmly bite down on 2x2 gauze pledget giving usual stoppage by pressure. If it continues, remove clot with forceps and use "Zonite" (douche) mouth wash. This promotes formation of normal haemostatic clot and promotes rapid healing. (It also prevents "dry socket" in freshly exposed sockets.)

SAFETY

CAMP SAFETY

1. Flammable, pyrotechnic and explosive stores must be kept at a safe distance to the leeward of permanent camps. These should be in separate classified (unmixed) dumps and properly flagged where there is a possibility of loss through drifting snow.

2. The above stores are picked up LAST by departing trail parties, and the departing trail is NOT through the camp.

3. Fire bills must be prominently posted, known, and followed by all hands. Duties and watches assigned MUST be closely adhered to. Fire drills and inspections must be thorough and adequate for safety.

4. Fuel drums must be adequately and accurately labeled as to their contents, and should NOT be reused for a different product without adequate changes in marking.

5. All hands must know how to use all types of fire extinguishers on each base. Extinguishers must be recharged IMMEDIATELY after use, and should be inspected regularly to ascertain their serviceability.

6. So far as possible buildings should not be connected by combustible passageways which might spread a conflagration. All buildings must have secondary exits opposite the usual door, which exits MUST be kept free of debris, stored materiel, trash and snow AT ALL TIMES.

7. Electric wiring must be adequate to the loads, must be properly insulated and fireproof, and should incorporate pilot lights in circuit with high resistance appliances to prevent their being left on.

8. NEVER fill oil stoves, lamps, or heaters with gasoline!

9. Utilize drip trays on all fuel oil appliances to prevent soaking the wooden decks of buildings with fuel oil.

10. A reserve store of fuel, food, clothing, survival gear, sleeping bags, medical stores and communication gear must be maintained at a safe distance to windward of the camp to assure personnel survival in case of general conflagration.

CABIN COURTESY

When you've borrowed another man's shelter to weather out a storm or a

season, there are certain rules of the road which should always be observed when you leave:

1. Always leave the water bucket and other cylindrical liquid containers empty and upside down, to prevent ice formation and breakage after you leave.

2. Leave the stove clean and fresh supply of dry wood under shelter.

3. Leave the dishes clean. An anonymous author left the following note in Scott's 1911-1913 camp at Cape Evans, "Please leave the dishes clean. Remember, you are going out full, but the man coming in has an empty belly."

4. Secure all foodstuffs in metal cans or boxes and put away small, particularly shiny items, to prevent their use or theft by pack rats.

5. Put all bedding, clothing, etc. which you may have had occasion to use back where you found it, or if it is rat-infested, store it rat-tight, if possible.

6. Secure all doors, windows, douse fires and put the snow cap back on the chimney to assure the cabin being snow-free and as vermin-free as possible for the next occupant.

TRAVEL IN GENERAL

1. Whether climbing a mountain, traversing a range, or exploring an unknown area of a polar plateau, start the expedition with a few shorter overnight and at least one longer trip before the main assault. On these trips one becomes familiar with the equipment to be used, and camping techniques will be perfected which will save discomfort and time at a later date.

2. Neatly pack sledge or back pack and assure security of all items before setting out, for a dropped canteen or stove, a tree or rock catching loop or bulge might have dire consequences.

3. Be sure that subsidiary dumps of food, fuel, etc. are secure from wildlife, are well marked for identification, and are well flagged against drifting snow. A line of flags at right angle to the direction of travel should preclude missing the depot through minor errors in navigation. Snow cairns show up further than flags, but may be destroyed by wind. Fuel drums are good markers for lonely tractor trains.

4. Itemize trip needs well in advance, then cross items off the list as the pack accumulates. This avoids forgetting essentials.

5. Keep weight minimum by discarding non-essentials, and by "living off the country" where possible.

6. Every method of travel has advantages and disadvantages. By combining two or more methods the limitations of both may be minimized.

a. Man Hauling. Three men can haul 400 lbs. weight, operate up to 30 days, at 15-20 miles per day, may cover 360-540 miles, traveling two out of three days. This is most flexible, over practically any snow conditions.

b. Dog Sledging of 2400 lbs. including 50 lbs/day dog food and 6 lbs/day man food can operate up to 40 days, at 20-30 miles/day, may cover 750-1000 miles. The dogs are a source of survival food to dogs and men.

c. Weasel Hauling of 4480 lbs. including 240 lbs/day of gasoline and 6 lbs/day man food can operate up to 18 days, at 40-80 miles/day, and may cover 1000-1080 miles. The efficiency of dog and weasel travel decreases with higher sastrugi and more numerous crevasses to zero. A prolonged period of bad weather can reduce efficiency of man and dog parties, but not remarkably affect a weasel party.

7. In crossing Arctic rivers, particularly in the spring:

a. Cross in mornings before the heat of the day causes more melt and rising water.

b. A safety line anchored securely to one or both shores should be used.

c. Remember the water is shallowest where the stream is widest.

8. When traveling, give an occasional glance behind. This will not only assure the straightness of the course, getting where you want by looking where you've been, lining up with at least two trail flags, but it may save valuable gear bounced off a sledge by rough sastrugi.

9. All weasel drivers should be mechanics. With respect for the work involved in repairs, they drive more sensibly, and the vehicles last longer.

DIRECTION AND TIME DETERMINATIONS

The art or science of navigation would be out of place in this manual; however, at times it is handy to be able to determine direction without a compass and time without a chronometer.

Within 500 miles of either magnetic pole and in certain ore lode areas, simple sun observations give direction more accurately than a compass, and may, in fact, be used in roughly determining compass variations in such places. Interesting simple geographic and astronomic facts of the earth's movement in the solar system are:

1. The Arctic Circle, 66°30'N, and the Antarctic Circle, 66°30'S, delineate areas north or south of which, in the boreal or austral summer respectively, there is continuous daylight.

2. Northern summer coincides with southern winter and vice versa.

3. At the geographic poles summer starts with weeks of twilight, growing lighter until the sun may be visible 24 hours per day, swinging about the horizon at daily higher azimuth until midsummer, when it begins to sink toward the horizon, a long sunset is followed by weeks of darkening twilight until the continuous winter darkness again sets in. Tomorrow night, same time, is 365-1/4+ days late later. All directions are south (or north); hence, aircraft navigation must be simplified by use of grid navigation, utilizing parallels to the Greenwich meridian and utilizing Greenwich time.

4. Between geographic pole and polar circle in summer, the sun hits a higher zenith at noon than at midnight--the closer to the circle, the nigher the noon zenith. Hence, the shadow of an unaak or ice axe stuck vertically in the snow is shortest at noon--and at noon this shadow points at the corresponding pole.

5. In Antarctica, if this shortest shadow points at a distant mountain peak due south at noon, it will be obscured by the peak at midnight. Facing the peak, the sun is left (due east) at 0600, directly behind at noon, and right (due west) at 1800.

6. Conversely to (5) above, if you have an accurate chronometer, the sun's observation, using the 24-hour clock, is easily converted into direction.

7. The Equal Shadow Method of determining direction is based on (4) above, and establishes the shortest shadow most accurately. In the forenoon, using a vertical rod as center, an arc is drawn on the ground or snow, using the length of the rod's shadow as radius. Mark this original arc-shadow crossing "A."

When the shadow tip crosses the arc in the afternoon, mark "B". Bisect line AB with point "C", and a line from the rod base through C is the shortest shadow, and points to the corresponding pole. If you're camped and your watch has stopped, tomorrow when the shadow hits point C, set your watch at 1200 (noon). In both north and south, line AB lies due West-East. Unfortunately, this method requires at least an hour or more of observation; also, depending on time of year, north and south may be reversed within the Tropics of Cancer and Capricorn ($23^{o}27'$N and $23^{o}27'$S of the equator.)

8. The sun "rises in the east and sets in the west" except within the polar circles, when it may be visible only momentarily in the north (or south) at the horizon, at noon. The nearer to midsummer and the further from the poles, the more accurate this observation.

9. The Watch Method for determining directions by the sun requires that the hour hand (or reference point on the face) be set to local solar time on a 24-hour clock, whose hour hand would circuit the face only once (starting at midnight, rather than twice on 24 hours. For example, at 8:00 a.m. (0800), the hour hand would point at the number "4" instead of the number "8". Using the above illustration, with the thin sun shadow of a vertical stick or string overlying the 4-10 axis instead of the 8-2 axis on the horizontal watch face:

a. In the north, 12 o'clock points due north
b. In the south, 12 o'clock points due south, EXCEPT in Antarctica

you must visualize your 24-hour clock as running counter-clockwise; 0200 is 11 o'clock on the clock face, 0400 is 10 o'clock, etc.

This is extremely accurate except that one must realize that Alaska time, Yukon time, and Pacific time, for example, are arbitrary, not solar, except at one longitudinal meridian in the zone, and are strictly for the convenience of society and commerce. (Daylight saving time is delightful but in no sense astronomical.) To maintain accuracy of direction during travel, true sun time must be redetermined more often with closeness to the pole and with increase in speed of travel.

10. The Shadow Tip Method of determining direction is a quick variation of the Equal Shadow Method, requiring observation for a briefer time. The longer the shadow-casting pole and the more vertical its axis to the sun's rays, the quicker and more accurate the determination. Mark "A" the tip of the shadow on the ground or snow. As soon as the tip has moved 4-6 inches or more, mark "B". If in doubt, later make a third confirming mark "C". AB and certainly AC will be the west-east line, and a bisecting perpendicular on the shadow side points north in the north between 0600 and 1800 hours, and south in the south during the same LOCAL SOLAR times.

11. Between 0600-1800 hours local solar time, if a shadow pole be pointed

directly at the sun so that it casts no shadow, when, after a short time, the pole does cast a shadow, it will point EAST, both in the Arctic and Antarctic.

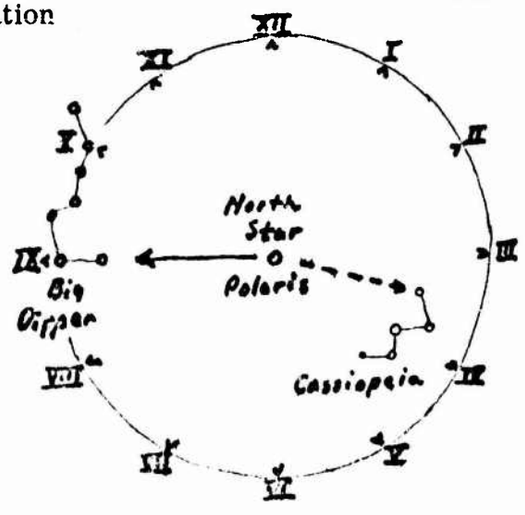
12. After nightfall in Antarctic regions, with clear skies, south may be determined by the Southern Cross, although in my experience it is MOST difficult to find in spite of the beautiful and simple sky charts to be found in survival texts.

13. After nightfall in Arctic regions, the two Big Dipper stars farthest from the handle point very close to the North Star, "Polaris," about five times the dipper "depth" above. Polaris' location may be checked by the bright five-star "W" of Cassiopeia opposite the Big Dipper and roughly the same distance away. Polaris rotates within 1^{o} of true north. On the Arctic Ocean it is difficult to determine true north because the pole star is so near the zenith. The further from the pole toward the equator the quicker and easier the determination of north (and checking perhaps of one's compass deviation?).

14. The Big Dipper indicator stars are directly above (12 o'clock) the North Star each year on 7 March at midnight. This allows a close observer with a formula to tell local stellar time within 15 minutes.

The formula is utilized as follows:

(1) With Polaris as the center of a watch face in which the vertical meridian is 12 o'clock through 6 o'clock, and an imaginary hour hand pointing at the two Big Dipper indicator stars, read the time as on a regular clock to the quarter hour if possible. For example, our illustration shows 9 o'clock. A = 9.



(2) Record the passage of time to the quarter-month since 7 March. Say the day is 30 May. 2-3/4 months have passed. B = 2-3/4.

(3) 24 (Use 48 if subtraction would give a negative number) -2(A+ B) = the time on a 24-hour clock. In our example, 24-2(9 + 2-3/4) = 24-23-1/2 = 0030. Hence, from 26 May to 1 June each year the above sky picture denotes the time to be within 15 minutes of twelve thirty in the morning.

If the Dipper is obscured by a cloud or is below the horizon, but Cassiopeia is visible, point the imaginary hour hand at the upper right-hand star of the "W" in Cassiopeia and record the time. The illustration above would point at 3:30 approximately. C = 3-1/2. Add 5-1/2 hours to the C reading to give A, then crank A into the above formula to get the time.

15. When its overcast, you're sunk! This is a good time to sit down and memorize this section of the manual in preparation for the reappearance of the sun or stars.

ALPINE SAFETY

1. Beware of starting (or being caught under) rock slides or snow avalanches.

2. When skiing on slopes, attach binding independently to ankle with strap or line. After a fall, your life may depend on one or both skis NOT sliding merrily into a valley or crevasse below.

3. Experienced hikers start slowly and finish strong. Steady travel at a comfortable pace covers more distance in the long run.

4. Hike with feet straight ahead. Swing hips to lengthen stride. Cushion stride with slightly bent knees, particularly on downgrade with heavy pack. On upgrades, plant the feet flat to save exertion on calf muscle and achilles tendon.

5. Peel clothes with exertion, but beware hiking barechested. Ultra-violet is much stronger at altitude, and packstraps murder sunburned shoulders. When resting, put on wraps BEFORE you chill.

6. Don't eat heavily then immediately exert yourself. Light snacks often when on the trail are easier on the digestion. The big, high fat meal is in the evening.

7. DON'T try rock work without advance practice under experienced guidance.

8. DON'T strike out across country unless familiar with the terrain, then check your whereabouts from time to time with good maps and compass.

9. Ridges are easier, safer walking than gullies, and they give a view of prominent landmarks. They offer two ways out of a bad spot. Select the easiest way, which rarely is the shortest.

10. On talus (boulder piles), stay on top, hopping from rock to rock. Learn to judge rock stability, and leave the hands free for balancing.

11. Scree (gravel slides) are almost impossible up, but are fast down, and safe if the stride is not too large. Sand on an underlying rock equals one sure fall.

12. In crossing deep and swift streams, remove socks and replace shoes. Wear back pack for added weight, but untied so it may be shed in emergency. A heavy pole will aid stability.

13. If lost, don't panic. Climb a hill for a view around. Don't be afraid to camp. Dry wood to start a fire even in the rain may be found on the lowest branches of most live trees or in a musky-smelling pack rat's nest under a big boulder. Garner a pile of wood, then a second one of equal size to be safe. If caught out without sleeping bag, find or make a reflector for the fire back, and for yourself, and keep a small fire (which you can get close to) going all night. When cold, you'll waken and feed the fire.

14. A big fire, on gravel or sand, will heat the ground in an hour so that when the ashes and coals are brushed down to a small fire for cooking in the reflector at the foot, 4-6 hours of comfortable sleep may be had with only minimal covering on the warm ground, on the fire-heated gravel.

15. DON'T keep going at night or if unduly cold or fatigued. You may take your last fall. Allow one to two hours to make camp before dark.

16. Campsites should be free from possible avalanche, have good water supply, ample fuel, and level, well-drained bedsites with protection from the wind. Canyon bottoms may be colder and windier than benches up the slope.

17. In making camp, fire and hot water first. Depending on situation, this is followed by shelter, bed (dry humus or grasses are far superior to green boughs, and approach an air mattress), eat, then bed. Use slit trench or "cat system" in one area, and bury all. Leave a clean campsite free of litter and with FIRE OUT.

18. Secure camp before retiring. In bear country, tie food in a tree with a few pots and pans to dangle together below the pack (like bell clappers), should a bear make midnight foray. Flashlights and sudden loud noises also frighten bears away.

19. Before retiring, make sure camp is wind and waterproof. Loose items are occasionally stolen by pack rats; boots are tasty to some small rodents. Secure all loose gear in tents or caches. Make sure the fire will not kick up during the night setting the woods or your equipment on fire.

20. On breaking camp while breakfast is cooking, burn all refuse, including cans. Bury non-burnables in the slit trench or "cat system" area, selected to provide minimal stream pollution, and bury all. Leave a campsite free of litter and a fire which HAS BEEN DOUSED WITH WATER. Buried fires are never safe.

AVALANCHE SAFETY

1. Avoid cornices or snowdrifts on the lee side of ridges. They often resemble ridge crests (with which they are continuous). Collapse of unstable cornices precipitate avalanches.

2. New snows falling on crushed lower layers, particularly those glazed by melt and refreeze, often avalanche. Dry snowfalls, starting during freezing temperatures, are avalanche-prone for one to four days. Snowfalls starting as wet snow in thawing temperatures are usually safe (if lower layers were similarly bonded).

3. High altitude melt, lubricating lower layers which may have become glazed early in the season, are particularly dangerous, because many thick layers may avalanche.

4. Grassy smooth slopes steeper than 22^{o} are more prone to snow sliding.

5. Heavy brush, trees and rock outcroppings anchor snow and show absence of recent avalanche activity. Avoid gullies, chutes, or inverted "V's" of talus slope, which are evidence of former slides.

6. Convex slopes are more dangerous than concave slopes.

7. When air temperatures are diurnally above and below freezing level, travel only during freezing temperatures, never during warm windy weather.

8. In the northern hemisphere, west and south slopes usually avalanche first and are safer earlier because of greater winter sun bonding.

9. Slopes are less dangerous at the top unless concave or cornice-crested.

10. If dangerous slopes must be crossed:

a. Walk, angling up or down with group members safely separated.
b. Watch snow above and below.
c. Loosen all pack, pole and ski bindings so they may be quickly abandoned if avalanche starts.
d. Each man trails 50-100 feet of red or orange line to assist searchers or for anchor security in crossing small gullies.
e. NEVER rope a skiing party together in avalanche country; ALWAYS in crevasse country.
f. Maintain silence. Handkerchief or muffler over the face is a good reminder and precaution (in dry snow).

11. If caught in an avalanche:

a. Cast off pack, poles, skis, etc. immediately.
b. "Swim" uphill, attempting to stay on top; avoid tripping, and have head out finally.
c. If you end up buried, create a face-breathing room with head and/or

hands, and unless alone, relax—they'll find you—conserve your energy (and body heat). Don't forget to stay awake and keep wiggling your toes to prevent freezing.

12. Searchers for buried avalanche victims: flag the most likely location, then:

a. Systematically (and gently) probe every foot with pole or ski in shallow moraine.

b. In deep moraine, dig ditches and systematically probe horizontally.

c. Avalanches, if slab, often crush; if wet snow, freeze or suffocate in an hour or so; if dry snow, may not harm; but in any case, the victim will need help getting out, particularly if head down.

GLACIAL AND SHELF ICE SAFETY

1. On glacial ice, crevasses may show up as white streaks of snow bridges between bluer ice of the shelf or glacier, or there may be NO SIGN WHATSOEVER on the surface of a dangerous bridged crevasse. On snow field, bridges may show as regular dish-shaped depressions running for distances in near-straight lines.

2. Stay away from areas showing numerous surface cracks or snow domes, for where there is considerable glacial movement, there are bound to be many dangerously bridged crevasses.

3. Old slumped bridges may be stronger than flatter bridges of newer snow.

4. Ice-axe and ski-stock probing is safe ONLY for most man-hauling or dog team travel. For tractor traverses, longer and heavier probes, such as crow-bars, are necessary for proving safe snow bridges.

5. Electrical crevasse detectors work well, but ARE NOT INFALLIBLE.

6. Heavy tractor train operations over crevassed areas require that all major crevasses in the path must be unbridged with explosives, then filled with snow from the bottom to the surface to allow safe passage of heavy tractors and their sledges.

7. When traveling on the plateau, avoid any disturbances of the surface. Long dish valleys are safest, with greatest danger of crevassing near the crests of north-facing slopes (in Antarctica).

8. Exposed rock or nunatacks are usually best approached from the western or lee side where drifting usually bridges any danger.

9. On polar plateaus, snow drifts hard enough to bury a sledge overnight about one-third of the time. Park vehicles at an angle to the prevailing wind.

10. Sastrugi, wind-created snow waves of six-inch to six-foot height, may be best crossed at a flat oblique angle, NEVER at right angles. Sastrugi crests indicate the direction of the prevailing winds, and may serve as a clue to directions in emergency.

11. Dunes formed by blizzards may be in any direction, depending on the direction of the prevailing high winds of the blizzard. Don't depend on dunes for directions.

12. Heavy tractors, snow-cats, etc. must work at least in pairs so there is sufficient power to extricate one vehicle in trouble.

CREVASSE SAFETY

1. Always travel in parties of three or more in crevassed areas.

2. Travellers should be equipped with:

   a. One or two 120-foot lengths of 7/16" nylon line; for tying party together.
   b. One or two 150-foot lengths of 5/8" hemp rope for crevasse rescues.
   c. Crampons and skis (one pair each, per man).
   d. Pre-cut slings and snapbits.
   e. Ice axes (at least one per man).
   f. Hunting knife for each.

3. Nylon rope stretches and is ideal for safety line, but because of the stretch it makes a poor line for crevasse rescues. Both nylon and hemp line should be carried.

4. The lead man should be equipped with an eight-foot bamboo pole, for an ice axe is not long enough to reach through Antarctic snow bridges.

5. Move only one man at a time with taut lines if in doubt. If it is icy the two rear men should be on crampons rather than on skis. Unless all hands are expert skiers or in case only two men must traverse crevassed country, the rear anchor man should wear snow shoes unless he is an expert skier. Even then, if one man falls down a crevasse and the other cannot hold him, the "Law of the Antarctic" dictates that the tie rope be quickly cut, for a man on top may rescue the man below, but if both go down they will both probably die.

6. Don't trust an axe belay in soft deep snow or in solid snow unless the shaft is buried over 3/4 of its length.

7. The best way to approach a crevasse is perpendicular to its line of flow. The thing to avoid is walking down the middle of a snow bridge.

8. In case of fall, don't stop the rope quickly, it might break.

9. If two men (or one) cannot effect rescue, make the man (men) in the crevasse comfortable as possible, leave food, fuel, and clothing if he is capable of using it; MARK THE SITE WELL; and leaving one man on guard, backtrack on skis for help.

10. On at least two instances a single man down a crevasse has effected his own rescue, so DON'T GIVE UP. Be alert; USE YOUR HEAD. Practice rope climbing and knot tieing BEFORE you find yourself down a crevasse.

SEA ICE SAFETY

1. Ice cliffs, whether glacial, shelf, or berg ice, are extremely dangerous, not only from falling from the top or through a bridged crevasse, but also by being buried by ice-falls if walking near the base. On warm days the whole face of a cliff or berg often falls with a thunderous roar. This is no place to chip ice for water melting.

2. In the open sea icebergs are dangerous, for they may turn over without warning. Because icebergs move with the ocean currents independent of wind, charts of ocean currents should be closely studied. A cruising berg may open a lead through sea ice useful for small boats or ships, or it can crush the largest ship caught between the moving berg and stationary floes or bergs.

3. Not only headlands with underwater projections, but also grounded bergs surrounded by sea ice often deflect deep currents so that nearby sea ice may become dangerously thin without visible evidence on the sea-ice surface.

4. Never camp on sea ice if it can be avoided. If you must camp on sea ice:

a. Make frequent observations of ice blink and water sky to help avoid opening leads, unless you're looking for seals (in the north, usually accompanied by polar bears).

b. Be prepared to move camp on short notice, for floes break without warning. Keep a watch if two or more in the party.

5. Daily measurements of sea ice thickness and inspection for working cracks, with flagging of danger areas, is necessary to assure safe tractor unloading operations.

6. When traversing cracks on sea ice in tractors, test all bridges driving by remote control, or at least have safety hatches open during such operations.

7. Better footing (with half the effort) may be had on Arctic ice, which has a

slight glaze and very tiny elevations (sastrugi) or indentations. New snowdrifts are smooth in surface and as difficult to walk in as soft dry desert sand.

8. Taste all sea ice snow before melting to water. You'll save much fuel, coffee, tea, etc. Old SNOW (which gives good footing) is VERY salty. New snow is fresh. Old blue ICE is fresh; new ice is salty (taste it too!).

9. Sea ice is wet--one needs boots waterproof 1"-2" up the sides. NEVER sit on bare sea ice. The Eskimo sits on a thick bear fur or on his heels. In camping, always have a waterproof ground cloth.

10. Always carry an eight-foot pole with metallic spike on one end (unaak - pronounced oo-nŭk) for testing depth of ice (particularly new "black" ice) for safety. The other end has a sharp hook so that if caught on an ice pan or bergy bit, you can pull yourself up to a larger floe. This pole also helps keep one from falling into an unsuspected old seal breather hole or a rapidly opening lead--maintains hand warmth and enables self-rescue.

11. If you fall in the water, clamber out as quickly as possible and roll in NEW snow on the sea ice surface. Its quick drying. Then keep on your feet and in motion. Your outer clothing quickly freezes, giving excellent wind protection, while inner heat of exercise dries out the cold, wet inner clothing.

12. In wind, sea ice forms first as a slush 10"-12" thick. If calm, surface "lily pads" form, and coalesce atop the slush. A superficial elastic, non-supporting crust atop slush give "BLACK ICE." If inadvertently caught on black ice, walk gently, with feet far apart IN A CIRCLE back whence you came. If you stop, back up, or make a sharp turn, you'll surely go through. This ice is most dangerous when covered with fresh snow (which not only obscures its detection, but insulates it from rapid solidification).

13. Rafting of two layers of black ice due to ice pressures may give a gray "path" which will support man in emergency.

14. "Turquoise" ice is often a thin layer of water over a trough of black ice. Never trust it without observing the entire area.

15. Large floes of flat ice in pressure are most likely to "raft" near the center to produce pressure ridges. Old pack ice may be quite thick with undulated, rather thin, jagged rafted surface. Patches of clear blue ice in this formation are usually salt-free and melt into excellent water.

16. In the Arctic, camp near big piles and preferably long ridges of old ice:

a. Climbed, they give excellent visibility of trail, game, or rescue efforts.

b. They are a source of fresh water.

c. If foraging from camp, a big long ridge makes camp easier to find.

17. In the Antarctic, stay away from large ice masses in the sea ice; they are:

a. Floating bergs which may roll and crush you.

b. Grounded bergs with treacherous thin ice nearby.

18. Currents and tides more often control the motion of bergs and loose floes of sea ice than winds.

a. Currents or tides may be detected and gauged according to speed by throwing a chunk of ice or snow in a lead and watching its course.

b. Offshore tides, currents and winds and working cracks parallel to the shoreline are most dangerous.

c. Ice cracks perpendicular to the shore and tangential tides and currents are less dangerous, but must be closely calculated. If you're on a floe which separates, run down-current - the lead may bridge or narrow sufficiently between floe and fixed ice that you may safely cross.

d. Frequently observe on all sides ice blink and water sky--reflections of snow fields or open leads in the overcast sky, and govern yourself accordingly.

e. Steam (or crystalline "sea smoke") may be observed rising from open leads in the sea ice against cloudless sky.

19. In clear weather, particularly in the north, and usually in Antarctica, if the direction of land is in question, observe that the horizon is sharp with darker sky and whiter snow over the sea, and it is hazier and at times indistinguishable (whiteout) with lighter sky and light snow toward land.

"ESKIMOLOGY"

1. Eskimos grow moustaches in winter to warm the upper lip--and condensed moisture gives a quick (though short) drink when most needed, by melting with the lower lip.

2. Eskimos don't like zippers for:

a. The wind goes right through

b. Warm wet skin sticks to cold metallic zippers and quick-freezes.

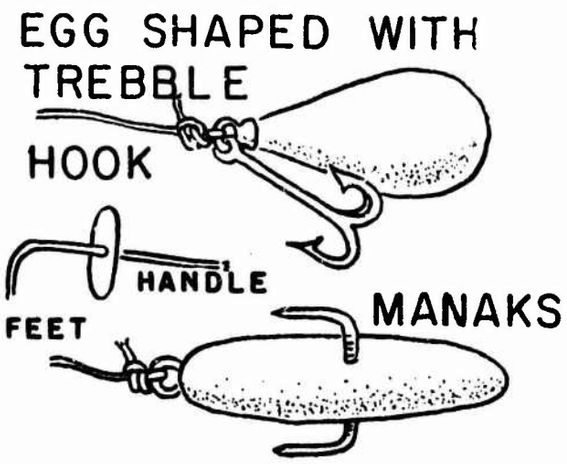
3. Eskimos would rather wear two pairs of cotton gloves than a pair of mittens for WORK. They wear mittens (fur) only for survival in extreme cold.

4. A "manak" (pronounced mŭnŭk) is always carried. These come in two or more varieties, but consist of a floating wooden weight with sharp hooks (large

fishhooks or nails) 60'-100' of small strong cord (parachute riser cord is ideal), and a small handle 3' from the manak with which it is thrown (from between 2nd and 3rd fingers). The manak has two uses:

a. Retrieving killed but floating seals.

b. Throwing from ice pan to floe to enable pulling one's self "ashore."



FLAT OVAL WITH TWO SHARP HEADLESS NAILS

5. Eskimos never go next door without a loaded rifle.

6. Besides rifle, manak and hunting knife,the Eskimo usually carries a sewing kit, telescope or field glasses,and always a watch, for he measures distances traveled by minutes or hours, rather than the deceiving and unpredictable visual impression. Watches are invaluable in planning foraging excursions in limited winter daylight. In continuous summer, if dependable, they are more accurate than compasses when the sun is visible.

7. The Eskimo usually travels with everything he or his team can haul. Most of the gear carried may never be used, but if it is needed, he has it. This is pleasant vindication for the author's oft-considered "pack rat" habits.

8. Eskimos are most meticulous about keeping ice and snow off and out of their clothing and equipment. They consider water good only for making tea, boiling chow and as the habitat for aquatic food and clothing in its native state.

9. The Eskimo NEVER travels in whiteout, blowing snow, extreme cold, or when he isn't fairly sure of future weather conditions.

BOAT SAFETY

1. ALL small-boat operations in polar waters are hazardous. Only such boating as is mandatory to accomplish a mission or to save life should be allowed. Fishing or pleasure excursions are verboten.

2. Boating must be authorized by the officer in charge in each case, after consultation with the meteorologist and assurance of continuous good weather.

3. No boat trips will be made on the leeward side of an island or headland in remarkable winds. Motor failure in such cases will result in drifting into the open sea with death likely for all hands before rescue can be accomplished.

4. All trips MUST be finished with the boat safe ashore at least one hour before sunset.

5. Motor must be tested and in perfect running order, fuel and oil tanks and reserves must be filled, and sufficient survival gear for all hands must be safely stowed aboard before any trip is undertaken.

6. Each boat crew must have one man designated skipper. Crews will number sufficient to efficiently propel the boat with oars should emergency arise.

7. Life jackets will be worn at ALL TIMES, and exposure suits should be worn at all times when subjects are not rowing.

8. Radio communications with the shore shall be maintained if at all possible.

9. Make for safety at the FIRST sign of change in the weather. Start rowing IMMEDIATELY in case of engine failure.

10. Small boat survival equipment will include fresh water, a floating knife, two to three days' ration per crewman, portable stove and fuel, matches, smoke flare or Very pistol distress signals, one ground sheet per crewman, oars and oarlocks secured to the boat, one anchor, one sea anchor, sufficient line, a bailer, a compass, charts of the area, and a first aid kit.

11. NEVER overload the boat to the point where unexpected waves will ship water, capsize or sink.

12. NEVER wear rubber hip boots on small boats in Alaska. Man can neither swim nor remove them in time when in the water.

13. If suddenly dunked from shore, scramble out as fast as possible. If from boat, or boat capsizes, get aboard as expeditiously as possible to avoid cramps and paralysis.

GUN SAFETY

1. Consider that EVERY gun is loaded until proven otherwise.

2. Point guns only where you intend to shoot and NEVER at a man unless you intend to shoot him.

3. Open action immediately on picking up a gun, examine for shell in the chamber, magazine or cylinder, and then for a clear barrel.

4. ALWAYS hand weapons to others, transport on ranges, lean on fence or trees with the action open. DON'T depend on ANY safety mechanism.

5. Always unload for storage, transportation or before handing it to another.

6. Never put a cocked pistol in a holster—loaded or unloaded. Carry pistols hammer down on an empty cylinder or chamber.

7. Know the logistics (lethal range) and penetrating power of your weapon, and always assure a safe backstop for your bullet. Remember that:

a. Trajectory will carry a bullet over a hill and kill an unseen man on the other side.

b. Water, rocks, retallic surfaces, etc. make bullets ricochet or "go around corners."

c. Bullets penetrate remarkable thickness of wood—in building or forest.

8. In case of misfire (except, e.g., when an animal is charging you) keep the gun closed and pointed downrange - it may be a "HANGFIRE."

Hunting Sense

1. Over-gun rather than under-gun. Don't hunt rabbits with a .22 in bear country—shotguns and big-game rifles also kill rabbits. If bird hunting with shotgun, carry two or three rifled slug shells for self-protection.

2. Never shoot offhand if you can shoot sitting or leaning on a tree—never shoot sitting or kneeling if you can shoot prone. Hits count; you eat more regularly and save ammunition.

3. On the hunt keep dirt, brush, mud, snow, etc. out of the muzzle by tying on a condom, finger cot, or finger from a rubber glove. It won't interfere when you shoot.

4. Know your rifle from personally and recently sighting it in.

5. Ammunition:

a. Transport in waterproof cans or plastic wraps.

b. Be sure it fits your weapon.

c. Use only expanding bullets of commercial manufacture. (NEVER trust your buddy's handloads if you want to stay healthy—and eat.)

d. Carry extra clips if your gun takes them.

e. Know the ballistics of every weight bullet you feed your gun. Heavier bullets have greater long-range killing power, but correspondingly greater drop and sighting difficulties than higher-speed lighter bullets for the same rifle.

6. Sights: Although the "West was won" (and Eskimos shoot) with open iron sights, they were better stalkers. If your life depends on shooting accuracy, use peepsights, or preferably a telescope sight of medium to low magnification in stable mountings, which obviates the necessity of 6-7X field glasses or telescope

to find game. A scope sight more often assures the safety of people beyond game range. Remember to aim low shooting downhill and high shooting uphill to compensate for lesser or greater gravity on the bullet. When shooting birds in flight, remember to LEAD.

7. Hunt quietly and from ridges or high places, but stay out of sight. You'll see more game to windward. Always stalk upwind.

8. Shoulder shots are easier. Neck shots kill most quickly. Dispatch downed game with another shot—don't risk being mauled in a knife kill.

9. Calves and females are better eating (and less waste) than old "trophy" males of almost any species, particularly the bigger game.

10. Conserve game animals—don't shoot more than you can use! Track game you believe might have been hit.

FIREARM CARE IN COLD

1. Transport empty in a waterproof carrying case NOT lined with sheepskin, for wool collects moisture and you may find your weapon rusty. NEVER store with barrel occluded with stopper, grease, etc.

2. Lubricate sears, bolts, triggers, slides, and other moving parts with molybdenum compound "Moly-Kote," for oils or grease cause moving parts to stick and malfunction in cold.

3. Keep barrel clean but don't wear it out. Modern non-corrosive primers do not collect moisture and do not cause rust.

4. The best barrel cleaner is hot soapy water and a wire brush. Rinse and dry thoroughly, then put "Rig" (grease) or "Sheath" (liquid) in barrel with bristle brush before gun stowage.

5. Protect outside of guns with "Rig," "Sheath" or sillicone preservatives to prevent rust, particularly if around salt water.

6. Leave guns out in cold or in entryway to prevent condensation and rust. If brought inside, bring rapidly to temperature several degrees warmer than room temperature. If condensation collects on the barrel, dry thoroughly inside and out.

7. Clean the chamber of high-powered rifles thoroughly with over-sized wirebrush to maintain proper head space and to prevent jams.

8. Carry plastic-coated, brass or aluminum cleaning rod (one-piece),

patches, lubricants, preservatives, wire and bristle brushes, a screw driver and a small Arkansas stone for maintenance.

ANIMAL SAFETY

Near larger animals, don't get between the mother and her young, particularly in case of bears or moose. Only old hungry or wounded bear, moose or mountain lion will attack man, and rarely if ever then if he smells man or fire.

1. Bears

a. Polar - has no enemy except man. Are curious and occasionally walk into camps seeking food. May be scared away by loud or unusual noises or unusual behavior, as when an Eskimo woman frightened one away by twirling several fishhooks about her head.

b. Kodiak - coastal, peninsular, Aleutian or Island (Boone and Crockett say they're grizzlies) are dangerous with young. You can smell them (old chicken farm) further than you can see them. They will run downhill. Tricks for elusion are:

(1) Cross the river.
(2) Rattle a can with rocks in it.
(3) Drop your fish and RUN.
(4) Climb up an 8"-12" sprunce tree at least 15 feet and prepare to stay there an hour or two.
(5) One rabbit hunter lay quietly on his face with a packboard over his head. A female with young who had attacked gave him minor bites on the arm, then ambled off. He lay still several minutes, then got up and hiked back to camp.

Best protection against these bears is probably rifled shotgun slug or high powered rifle with heavy hollow-point bullets. DON'T carry a pistol, even a .44 magnum, unless you're truly foolhardy or professional.

c. Black or Brown Bear. These camp pests are attracted to food, fat, salt, or sweet (smoked ham or bacon is ideal "bait"), and they will maul and wreck to get it. Chief problem is food storage, which should be high on a pole, platform, or tied high between two trees.

2. Wolves. These are now so extinct as to be very rarely seen. They have had to be imported to the Alaskan peninsula to preserve natural selection of the fit in caribou herds. Old tales of the frontier said they attack man only when starved and when man has no fire or ammunition.

3. Wolverine. Caracajou, the devil, a prized fur animal rarely seen even in remote areas, is the robber of traps and deadfalls and the cleverest raider on stored meat products. Unchewable wire must be used to secure high food

caches. Never known to attack man.

4. Mountain Lion. (Cougar, painter, panther or puma) of wild tale on the early frontier can scare you to death with their screams around a campfire, but he's deathly afraid of man.

5. Moose. Have been known to charge man when wounded or when protecting young. Head for the thick timber, climb a tree, or shoot fast and accurately.

5. Killer Whale. Orca is found in both Arctic and Antarctic waters. Scott in 1910-11 recorded an attack by a killer on his photographer, in which the whale apparently thinking man was an upright seal seemed to try to upset the floe on which Ponting was momentarily marooned. Shooting one and drawing blood is said to turn his packmates into cannibals, but they are potentially dangerous and should be given wide berth.

7. Insects. In the Arctic, midges (no-see-ums), mosquitoes, black flies and deer flies can make man's life miserable with their bites, though they carry no disease.

Headnets, gloves, tight-sleeve shirt, trousers tucked in socks protect during the daytime. Mosquito nets over beds protect during sleep. Fire smudges and sprays are of little use.

Application of recently perfected insect repellents to face, neck, ears (occlude with light cotton pledget), wrists and hands is uncomfortable, burns the eyes and lips, dissolves many plastics, but gives fair protection. Among the most popular are Cutter "Insect Repellent," "Off," and "6-10." Oil of citronella doesn't phase these pests.

AVIATION SAFETY

In the past 30 years aviation has become such an integral part of polar logistics, ice scouting, search and rescue, and exploration that cold weather medicine is properly a specialty of aviation medicine. During five summer operations the author flew over 20,000 miles in 66 flights in 10 different types of aircraft over Antarctica, crashing only three times.

During this five-year period there were 21 crashes of U.S. Navy and Air Force aircraft, eight of which produced 18 injured and 13 dead. This made Antarctic flying during this period about four times as dangerous as all other Navy flying put together, and points up the importance of aviation safety and survival in polar operations.

Pilots Should:

1. Keep in top physical condition.

2. Train crews so that all emergency procedures are second nature and automatic.

3. Assure that complete survival gear for all hands is aboard on all flights, and that on big planes important supplies, like stoves, food, sleeping bags, and first aid kits, are split fore and aft insofar as possible. Check-off lists are handy for this too!

4. Assure that passengers are briefed on emergency procedures to minimize panic and loss of life in case of emergency, ditching or crash.

5. Know the weather as far as predictable. You can't hurry the weather, and no matter what the emergency, don't take off in blizzard, fog, or whiteout. In the north, short winter days demand strict scheduling if not to be caught in the air after dark. If caught, be prepared with functioning navigation and landing lights.

6. Preheat engines and/or oil and turn prop through at least three times before starting.

7. Never attempt takeoff with ice, snow or frost on wings or control surfaces.

8. Be positive of the plane's ceiling, endurance, load and fuel supply, and the navigational aids, radio frequencies and weather en route, at destination and at alternate fields (if any).

9. Fill gasoline tanks IMMEDIATELY on landing to minimize condensation. Drain sediment bowl just before takeoff and immediately after refueling.

10. Realize that radio altimeters are unreliable over ice and snow, and that on long flights radical weather changes may make his barometric altimeter unreliable en route.

11. Watch for snow banks at the ends or sides of sea ice or land runways--they snag wings and snap off landing gear.

12. USE that check-off list! Particularly check carburetor heat control and carburetor air temperature gauges before takeoff.

13. Assure that in-flight cabin temperatures are cold enough that proper clothing can be worn without sweating, particularly in flights from warm into

cold areas.

(a) There's less shock than with sudden exposure to cold.
(b) More clothing gives more and better flotation.
(c) Your clothing is on--not lost in the shuffle.
(d) Your clothing fits YOU. No one is "average size."
(e) There's less chance of a faulty heater causing carbon monoxide poisoning.

14. Get in the habit of wearing those yellow glasses for landings, takeoffs, whiteouts, cloud-busting--they increase your depth perception, vision of crevasses and sighting of other airborne aircraft. (The whirlybird pilots swear by them and depth perception's their best life insurance.)

15. If icing occurs, remember that stalling speed remarkably increases; climbs are slower and turns are fast and wide. When flying in rain or snow, move control surfaces frequently to prevent runback freezing. If takeoff was on wheels from a slushy runway, actuate landing gear to shake loose ice which might freeze the gear in the well.

16. Landings on Arctic lakes should be made:

(a) Near the shore in fall and winter when they are freezing.
(b) Near the center when lakes have begun to thaw.

17. In water landings on Arctic rivers, avoid small stream inlets for a sand bar may wreck your pontoon.

Navigator should:

1. Know location of plane at all times to assure prompt and accurate search and rescue in case of emergency or crash landing.

2. Realize that magnetic compasses are not to be trusted within 500 miles of either magnetic pole. Also lightmeters (photoelectric cells) 3"-3' from magnetic compass will throw it off 15^{o}-30^{o}.

Crew should:

1. Know their emergency stations, crash and emergency procedures.

2. Keep all loose gear tied down and on the floor of the plane if possible.

3. Wear hard hats for all landings, takeoffs, rough weather, whiteout (and crashes).

Passengers should:

1. Stay out of propellers and prop wash; one kills, the other freezes.

2. No smoking in or about aircraft without the pilot's permission, and NOT 'HEN if you smell gasoline fumes.

3. Stay strapped in your seat with seat belt and shoulder harness (if available) from beginning of flight until all motion has stopped at the end. Minimize novements about the aircraft and distraction from their duties of a busy crew.

4. Don't worry; it upsets the crew. And it's a good landing if you walk away rom it!

ALL HANDS should:

1. Dress with sufficient stuffing under outer wind layer so that they can lay nconscious in the snow for 24 hours without freezing to death. In a flame, wool risps, nylon melts, cotton flames. Wear cotton-nylon or leather--you're safer f the landing's hot.

2. WEAR LEATHER GLOVES on ALL flights.

3. DON'T wear laced oxfords, boondockers, or "what have you" under flight oots or galoshes.

4. Don't lie about your weight or the weight of your gear. Vanity cometh before the fall, particularly in weight-sensitive helicopters!

So You're Going to Crash:

A. At Sea:

1. All hands are wearing exposure suits (which multiply life expectancy in polar waters by 10-20 times), Mae Wests, and gloves which they will keep on before, during and after. Be sure the back of the head and neck are well covered. They are using safety belts, shoulder harnesses, and hard hats if available.

2. Pilot lands parallel to ground swell if any.

3. The passengers will stand by quietly until the crew gets life rafts launched, and all hands will board, keeping as dry as possible in the process.

4. Watches will be set to:

a. Assure bergs, rain and other sources of fresh water are taken advantage of.

b. Grind out emergency radio signals on the prearranged time schedule.

c. Make sure the sea anchor minimizes drift from the navigator's last known position.

d. Assure all rafts (and there may be several) stay tied together.

e. Signal the search and rescue aircraft when it comes over with:

(1) Water dye marker

(2) Smoke grenade

(3) Flashlights or signal mirror

f. Assure recovery of air drops.

B. <u>On Land or Ice:</u> (Ride it in. If you bail out, you're lost, alone, hard to see from the air, and have little survival gear.)

1. All hands are clothed for the GROUND temperature. They are wearing proper clothing and LEATHER GLOVES. They are secure in their seats, and <u>they stay that way</u> until all motion stops.

2. Pilot lands parallel to sastrugi ridges if possible. Landings near the heads of glaciers give safer footing (crevasses) than those made at the foot of a glacier.

3. When the hatch is open, abandon ship speedily or at leisure, depending on conflagration.

4. Save the engine oil; let it run out of the hot engine on the snow if you've no bucket. It will congeal and is handy as fuel or for signal fires. Do this first, for when the engine cools, the oil won't run.

5. Care for the injured, recover all survival gear, then make shelter, post watches, and everyone else climb into sleeping bags to stay warm with a minimum of internal and external fuel.

6. Set the watch which:

a. Melts water and serves all hands.

b. Cooks meals.

c. Grinds out "Gibson Girl" radio SOS on schedule.

d. Lays out ground-to-air signals.

e. Watches for SAR aircraft, which when seen he signals with:

(1) Smoke grenade

(2) Rubber and gasoline

(3) Oil and gasoline-soaked LONE fir or spruce tree which burns brightly and with smoke

(4) Signal mirror

7. <u>NO ONE</u> leaves camp for help unless:

a. It is necessary to be picked up by SAR

b. Civilization is POSITIVELY KNOWN to be only a short distance away, and then this travel is NOT made at night, in a blizzard, in fog, or in whiteout.

Ground Search and Rescue is Good:

1. If the crash is within sight or easy range and capability of ground vehicles.

2. If SAR aircraft can't land or drop there.

You're on Search and Rescue Flight:

1. Don't "cloud bust" in sticky weather, particularly in mountainous country. No sense in someone else looking for TWO planes. The crash you find may be your own.

2. Maintain frequent communications with ground party or with base of SAR operations.

Helicopter Pilots in Particular:

1. If whiteout, fog, blizzard, sea smoke, or low clouds begin to obliterate part of the horizon, use extreme caution during further operations (even when you're wearing the yellow glasses).

2. Don't play hide and seek with the edge of ice shelves, bergs, etc. Those eggbeaters are expensive, and they, too, have poor depth perception.

3. Don't get fatigue. This causes carelessness, loss of judgment, and perceptive illusion, all of which are conducive to brisk swims, unexpected hikes, and/or embarrassing appearances before board of investigation.

4. Pickup will be by landing and takeoff, or by hovering after a pass or two to determine suitability of the rescue site, wind, turbulance, etc.

5. Approach all single main rotor helicopters at a crouch from the side in view of pilot or copilot to avoid rotor blade suicide.

If You Must Bail Out:

1. Don't maneuver your chute above about 2,000 feet over the terrain; you may be too tired when you must maneuver it to avoid ground hazard.

2. Relax--look forward, not down.

3. Keep feet and knees together, with knees slightly bent.

4. Remember previously jettisoned survival gear will be found UPWIND!

Save That Parachute For:

1. Shelter (tent, lean-to, etc.)
2. Bedding
3. Bandages or stretcher
4. Fish line, fish nets, snares, slingshots
5. Clothing, snowshoes
6. Wicks for stoves
7. Back packs, man-hauling sled harness
8. Sea anchor or sail
9. Safety line
10. Signalling

SURVIVAL

Survival training is life insurance. You're your own beneficiary. The only antidote for fear is FAITH based on experience and good planning. If you have no faith in yourself or your equipment, get out and "mix it up" with Mother Nature, for you can't respect her if you don't know her.

When you climb aboard a vessel, ship or aircraft in or going to the Polar regions, you are participating in an accident which is about to happen.

This does NOT mean that you're to scare yourself to death, for hysterics and indecision based on fear, Kills Kold "Kobbers." And don't write home thrilling letters which will scare your wife or girl friend half to death, showing what a hero you've been to survive. NOR does it mean you're to take the attitude, "It can't happen to ME!" Because it has, and to better men than you.

You must "BE PREPARED." (There's that "Ego" Scout again!) Physicially you will have your survival gear aboard, and will know automatically where it is at all times. Psychologically you will HAVE A PLAN. PREPARATION gets the right gear at the right place at the right time. PRECAUTION demands you won't take unnecessary chances. Note the fire escapes, the emergency doors, the fire extinguisher. Plan BEFORE it happens, then you won't freeze to useless inactivity when it does.

The Naval ship which is beset, sinks, or is run aground to save it (and your supplies) turns a sailor into a bonafide explorer type. Many who've sailed towards the Poles have walked home--and some unthinking and unprepared sailors haven't made it!

IF IT'S HAPPENED, hunger, thirst, fatigue, pain, loneliness and frustration can kill as surely as can the cold, through panic or irrational thinking. Sensible activity, humor, ingenuity, faith (and luck) have pulled many through.

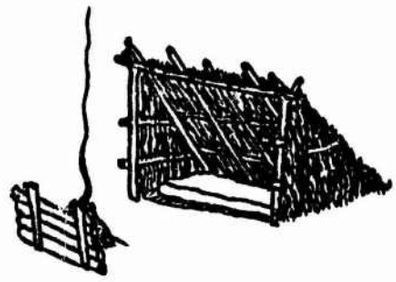
Polar survival demands organization for maximum saving of body heat with shelter and insulation, maximum utilization of available food and fuel heat sources, and minimum waste of body energy. Stay in bed when shelter, signals, snares and deadfalls for food are set, and avoid aimless activities or fruitless work "just to keep busy."

HOUSING

In order of importance to survival, shelter comes first. Tents have been discussed on p. 8. The covered inflated big liferaft pulled up on an ice pan is an excellent shelter, and gives unusual safety to personnel and supplies should a sea ice lead unexpectedly open.

1. Lean-To's (Arctic)

Where evergreens may be obtained shelter as illustrated may be built on two "A" frames with bough thatched roof and ends. Such a frame may also be covered with a parachute to give a tent. The chief virtue of a lean-to is shelter from the prevailing wind. When the brisk fire (in front of the log reflector) goes out there's no warmth.



2. Windbreak (Arctic or Antarctic)

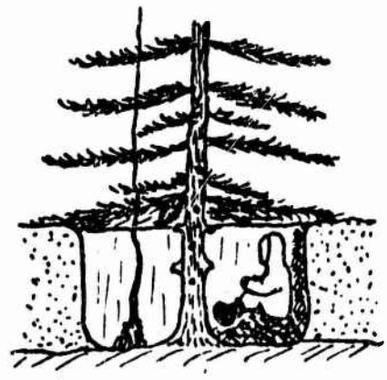
This will be built of snow blocks and will more or less resemble a lean-to in structure. If you're going to that much trouble why not go to a little more and build an igloo?

3. Tree Shelter (Arctic - These are extremely hard to spot by Search and Rescue aircraft!)

Where snow is 3 or more feet deep with drifting:

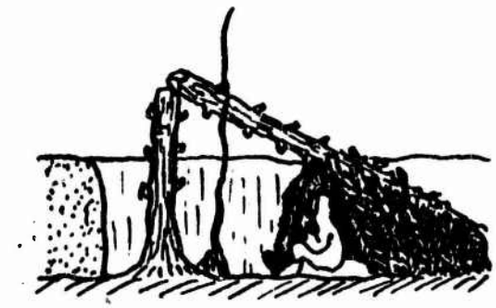
a. Upright Tree Shelter

The lower branches (in the snow and to 1-2 feet above the level depending on limb sag and type of tree) may be chopped off as the snow down to the roots is excavated. This gives shelter from the wind, and even without added cover using shelter half, poncho, parachute, etc., the tree shelters, from added snow fall, and a small fire should give comfort.



b. Felled Tree Shelter

A large evergreen tree should be felled 5'-7' above ground. By tunnelling snow and chopping off bottom limbs, using them to thatch open spaces between limbs on top and side a snug shelter may be built under the hole.



4. Snow Hole

For temporary one-man shelter to rest over a brief time a 3'x 3' x 7' trench in the snow, covered by ski pole and ski framework and covered with poncho, parachute, etc., Akja or ahkio sled makes good insulation for sleeping bag - there's no room for fire or cooking - it is simply good protection from the wind.

5. Snow Dugout

This is a larger, deeper hole excavated in deep drifted or glacial snow. Blocks cut in excavation piled around the periphery of the hole give double the depth with half the effort. Roofed with parachute, life raft, etc. (well anchored from loss or draughts by high winds) these can be good wind protection, but they are almost impossible to efficiently heat.

6. Snow Cave

Tunnelled into hard well set drift or glacial snow 2-20 man caves may be built. The harder the digging the safer the cave.

7. Igloo

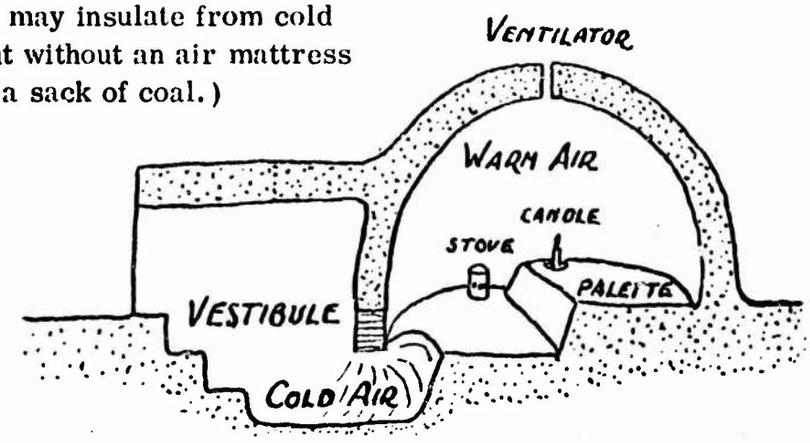
Essentially a snow dugout with a college education. Snow blocks dug by men outside are laid in a circular pattern by the inside man, leaning successive tiers closer to the center until, as Bruneleschi built the dome of Santa Marid de Fiori in Florence (copied by Michaelangelo in St. Peter's) a hollow hemisphere is built. Cracks are chinked, entrance tunnel made, then inside is heated until it ices, making it windproof.

8. Sod Dugout

Similar to 5 above, utilizing sod and rock (on a well-drained knoll or hillside) and usually with a more permanent roof of timber, etc. This is the type of house used by Siberian natives and most Eskimos. They may have double air-insulated windows of clear ice which when rimed on the inside are scraped smooth and translucent again.

In all of the last four shelters certain principles must be followed to give comfort. Like the Eskimos' clothing, the bell principle keeps these shelters warm. Warm air arises, so the palette must be above the level of the top of the main room entrance.

(Fir bough beds may insulate from cold snow, or ground, but without an air mattress it's like sleeping on a sack of coal.)



Vestibules keep out much wind and cold air. They may be closed almost completely at night by ice block, door, animal skin, etc. to limit entry of cold air. The ventilator is a simple hole or tunnel to the outside which may regulate the amount of air flow in many ways, but this absolutely essential to prevent death from CO or CO_2, particularly while cooking. At night, air flow may be diminished, but the hole should always be open to some degree. If fairly air-tight a candle will not only heat one of these shelters to a comfortable degree but it is indispensable in detecting anoxic decrease of oxygen in the shelter (see p. 78).

Entrances to shelters should point 90° to the prevailing wind line in order to diminish blocking the entry by drifting snow.

SURVIVAL HEAT

ANTARCTIC (and ARCTIC OCEAN)

1. Stoves

Inland in Antarctica, or on Arctic or Antarctic sea ice, some form of stove is essential for survival. These range from 2-3 burner pressurized gasoline or butane camping stoves to individual gas, gasoline, kerosene or alcohol burners. From a logistic, economic, and safety standpoint, the most efficient fuel stoves in the author's experience both north and south living on the sea ice are primus kerosene stoves.

a. Gases. Methane (CH_4); ethane (C_2H_6); propane (C_3H_8) and butane (C_4H_{10}) stoves are logistically impractical except in permanent camps. These straight chain (aliphatic) hydrocarbons are gases at ordinary temperatures, are manufactured or "natural" gas used in civilization. They are all dangerous, for leaks cause explosive and suffocating atmospheres.

b. Gasoline is a mixture of liquid aliphatic hydrocarbons of 5-9 or more carbon atoms, rated as though all oxtane (C_8H_{18}). Less volatile "white gas" with flash point -36°F. is of lower octane rating (56-100) and higher molecular weight. More volatile (and dangerous) aviation "petrol" of 110-145 octane and flash point -50°F. has lower molecular weight. These are used in stoves and lamps under pumped pressure or with carburetor preheat pressure (Swedish primus) stoves.

ADVANTAGES	DISADVANTAGES
1. Fuel handy for gasoline - burning aircraft survival.	1. Extreme fire hazard!!
2. Burns with about 800-1300 KCal/gm fuel.	2. Very sooty fire--dirties camp and speeds snow melt on clothing.
	3. Stinks up the pack and flavors food not kept airtight.
	4. Contact with covered skin produces painful burns.

c. Fuel Oils (Coal Oil) are mixtures of aliphatic hydrocarbons from C_6 or C_7 (liquid) to C_{16} to C_{20} (solid, but in solution of lower molecular weight liquids). They vary in solubility from lighter jet fuels, JP_4 to JP_1, to Fuel Oil #1 (commercial Kerosene or "campout fire starter.") It varies in flash point from -10°F. (JP_4) to 100°F. (Fuel oil #1).

ADVANTAGES	DISADVANTAGES
1. Less fire hazard than gasoline	1. Usually must carry fuel.
2. Burns with approximately 1600-2600 KCal/gm (HOTTEST fire per weight of fuel).	2. Sooty fire.
3. Handy fuel for jet-fueled aircraft survival.	3. Stinks up pack and food.

d. Alcohol

(1) Methyl alcohol (methanol, wood alcohol, CH_3OH) is produced by the destructive distillation of wood. It is a liquid, freezing at -98°C. (-144°F), and boiling at +65°C. (149°F.), Flash point is 60°F.

ADVANTAGES	DISADVANTAGES
1. Least sooty flame.	1. Blinding and deadly POISON, if injested.
	2. Usually impossible to tell from ethyl alcohol, except by chemical tests.
	3. Must carry fuel.
	4. Burns with only 171 KCal/gm (least heat of liquid fuels).

(2) Ethyl alcohol (spiritus frumenti, CH_3CH_2OH) is produced by natural fermentation of sugars. This liquid (commercially 95% alcohol, 5% water, freezes at -115°C. (-265°F.), boils at 78°C. (172°F.), flash point 70°F. This is the fuel long utilized in naval torpedoes ("pink lady"). Small, light, fairly efficient carburetor stoves of Swedish and German manufacture are on the market.

ADVANTAGES	DISADVANTAGES
1. Relatively sootless flame.	1. Must carry fuel.
2. Doesn't stink gear or food.	2. Difficult to distinguish from methyl
3. Twice heat/gm fuel as methyl alcohol.	3. 1/8 heat of kerosene; 1/3 of gasoline/ unit weight.
4. Little fire hazard.	4. Expensive.
5. Good disinfectant.	5. Often stolen or "misplaced."
6. Excess fuel is an excellent drink.	6. Hard to light at temperatures below 0°F.

*Soaping the outside of cooking pots and frying pans prior to use, whether over fuel stoves or fires, permits easy removal of soot prior to replacement in the pack.

2. Improvised Stoves

a. Gasoline or aircraft fuels, straight or mixed with engine oil, may be utilized in a #10 or larger can with 2"-3" of sand or asbestos insulation in the bottom. Punched holes 3"-4" above the bottom give draught; escape holes near the top will vent when can is covered with a pan. BEWARE carbon monoxide poisoning!

b. Any non-inflammable heat-resistant dish may be used with skin, bone or cotton-webbing wick (nylon's no good) to melt and burn animal or bird fat, candle fish (a very oily species of smelt), and engine oil. The fire is smoky and inefficient but it will melt ice or snow in a pinch.

ARCTIC (Subarctic and Mountain)

Fires are necessary for long survival in the cold (in varying order of importance) to:

1. melt and purify water
2. cook
3. dry clothes
4. provide warmth
5. signal
6. boost morale.

Build fires on ground scraped bare of extinguishing snow and moss, leaves, grass and/or humus, which spread fire. If snow is too deep for clearing, build

your fire on a wet or green double log or rock platform. Have ALL materials at hand, for a break in sequence means you start over (and it may be your last match). Shield all fire starting from the wind.

WITH	IGNITE	
a. cigarette lighter	candle	Contact tinder and gently but steadily blow coals to flame and small flame to bigger flame if draught or wind is insufficient.
b. 1/2 waterproof match	flame	
c. coal from friction of soft dry on hard dry wood		
d. flint and steel spark		
e. live battery spark		
f. ice or glass (camera, field glass) lens focusing bright sunlight	black or charred wood or cloth	
g. signal flare	fire into	
h. cartridge (with pulled bullet)		

Apply flame under a "teepee" of small dry twigs under larger "teepee" of dry larger sticks, under a still larger "teepee" or pyramid of logs with the driest ones nearest the fire. Be sure your tinder and/or twig and stick "teepee" are not crushed or compressed before they have thoroughly ignited the heavier wood above. A little gasoline or coal oil helps ignite the smaller sticks, but beware of flash burn when using gasoline.

Collect and dry tinder wherever and whenever you find it on the trail. Always save some of your best tinder to renew or revive a quick morning fire. Good tinder is dry fine shavings, conifer needles, dry inner tree (e.g., birch or cedar) bark, grass, lichen, moss, cattails, "Alaska cotton," cotton lint or threads, old bird or mouse nests, feathers and fine steel wool, the last of which ignites beautifully and burns almost explosively with an extremely hot fire when contacted with electric or flint-and-steel spark.

FUEL

In far northern latitudes, lichens, moss, heather, willow and alder bushes and scrub trees, as well as animal fats, are usable natural fuels. The further south the bigger and more plentiful the timber. On all coastal and island areas, there is driftwood which, if dry, burns prettily, hot and fast, though with considerable heavy ash. Driftwood rapidly dulls knives, axes and saws.

Dry fuel may be best obtained from standing dead timber, dead lower limbs of trees, from pack rat nests under big rocks, from the hearts of fallen tree

trunks. Green wood, particularly conifer or evergreen, burns well if finely split.

Birch is best of the northern hardwood or deciduous fuels. Aspen gives a hot fast-burning fire. Dry alder burns fast and hot. Many prefer green alder smoke to hickory for preservation of fish and game

Spruce, hemlock, pine, fir and cedar (conifers) give the hottest fires, particularly pitch-rich roots and knots, but these also give sputtering, popping fires which throw destructive hot coals on precious survival clothing and equipment. Never smoke fish or meat with these woods.

TOOLS

All sharp-bladed tools must have sheaths, manufactured or homemade, to prevent personal injury during transportation and to maintain sharpness.

1. Knife. Absolutely indispensable in the north. Many prefer harder temper blades which require less sharpening, but which chip or nick more easily. We prefer softer blades more quickly and easily sharpened.

2. Carborundum. Indispensable for keeping knife sharp.

3. Hatchet. Better than NO chopping blade but tempting lightness makes it wasteful of energy and good morale in timber country.

4. Axes.

a. Single-bit (Hudson's Bay, pole or peavey axe) 2-1/2-3-1/2 lb. head 26"-30" handle. These are useful for heavy camp work and pounding, e.g., stakes, if not too heavy, will not injure. Indispensable in large camps.

b. Double-bit (cruiser or Michigan) 2-1/2-3' lb. head, 26"-30" handle. Sharpen half as often but twice as much. Easy to sharpen with one edge driven into a log or stump.

c. Survival. 2-2-1/2 lb. head with 24"-26" handle to single-bit design. Compromise between weight and work in axes. Handy on survival in timber country.

5. Flat-blade steel file. Indispensable for keeping axes sharp.
NOTE: For survival purposes, dry wood may be broken by leverage between two trees, or by using a rock as a fulcrum. Big timbers may be burned in two.

TYPES OF FIRES

1. Cooking. To support pans, use rocks or green wet logs on either side

of small fire of coals, or build the fire in a narrow trench parallel to the prevailing wind to assure draught.

2. Warming.

a. A reflector of metal, rock, sod or wood on one side of the fire makes it more efficient and saves fuel. If your campsite has a big boulder or is at the base of a cliff, DON'T build your fire at the base of this natural reflector--sleep at the base of the cliff or rock, with the fire (with or without reflector) outboard.

b. There is only one use for a BIG fire! On a 7'x10' area of dirt free of roots and humus, build a fire over a 4'x7' area and stoke it high for at least an hour. Scrape the coals to a pile on one side of the cleared area (they make an excellent cooking fire). Make sure there are no coals or extremely hot rocks on the area of hot ground and cover it with your blanket, sleeping bag, spare clothes or grass and leaves, to retain the earth's heat. You'll sleep on top 2-3 hours, then wake and crawl inside for another comfortable 2-3 hours of uninterrupted sleep.

c. If caught with no bedding, a. and b. above will assure a good sleep of 4-6 hours, though you may SWEAT early in the evening.

d. Nying fire (Swedish) burns all night without tending. A 6'-8' log 12"-18" in diameter is split lengthwise with axe and wooden wedges. The inside surface of both halves are roughed up, then with the two halves horizontal, separated by 3"-4" faggots, tinder and chips are inserted at two or more places and the log's dry heart wood is set afire. When the log is burning well, one faggot and later the other may be removed.

e. To assure your "teepee" or pyramid fire lasting overnight, start rotten, "punk," or partially dried fuel at bedtime, cover lightly with ash and dry earth, and it ALMOST always will still have hot coals in the morning.

3. Signalling. Set ready to kindle three (3) big teepee or pyramid fires in a line perpendicular to the prevailing windline, and far enough apart that three distinct smoke columns will be visible from the air or distant peaks. Have each ready to quickly light by birch bark, stick with curled shavings or oily rag torch, with bottom access to tinder inside. Cover (indicated below) will help protect your fire from rain or snow.

a. Summer. Against green, black or brown background, white smoke is most visible. Over each prepared fire have a large stack of fresh evergreen boughs or green leaves which burn with a white heavy smoke.

b. Winter. Against snowy or white background, black smoke is most visible. Over each fire put pieces of life raft, wing de-icers, extra rubber boots,

raincoats or engine oil, which produce black smoke. If these are not available, a red smoke flare burned in one or more of the ascending white smoke columns will attract attention much more effectively than if fired alone.

WARNINGS

1. On the trail carry only "lucifer" (kitchen or farmer) matches, which will light with any friction or heat. Waterproof them by dipping them in barely-melted paraffin of low melting point.

2. Break your waterproof matches in two BEFORE you start--you can carry twice as many live halves (to light a candle) in your waterproof match box, and they're umpteen times more efficient.

3. NEVER depend on safety matches, for if the striker gets damp, you're sunk.

4. In permanent camps or cabins, use safety matches or lighters. Be sure to keep all kitchen matches in a tight-lid glass or metallic can to keep rats or mice from inadvertently setting fire to your diggings.

5. In camp, build a fire and DON'T squander matches on smokes. If you smoke (or even if you don't), carry a windproof lighter, extra flint, wick, and fuel.

6. If your first and/or second match doesn't start your fire, THINK what you're doing wrong!

7. NEVER REFILL a burning or still-hot gasoline stove or lamp. NEVER pour gasoline on fire or hot coals. BEWARE flash fire when starting a fire with gasoline. Kerosene, fuel oil and JP aircraft fuels are somewhat safer, but are still somewhat dangerous.

8. DON'T try gasoline in alcohol stoves. Alcohol and other fuels won't function in most gasoline appliances.

9. When the candle flame in your igloo or snow cave shortens from 1" to 3/4", probe your air vent; its drifted over and you're "drifting under."

10. Be extremely careful when (or don't) siphon liquid fuels at sub-freezing temperatures. A mouthful is not only painful and disabling, but might kill.

11. Practice the basic principles of good woodsmanship in using knife and axe, e.g., a few:

a. Make sure of brush-free swing area when chopping.

b. Chop against another log.

c. Sharp tools are less dangerous than dull ones.
d. Protect your axe handles by carefully gauging where the head will hit.
e. Never use an axe or hatchet head for a wedge. Cut wooden wedges.
f. Chop or cut AWAY from you.
g. Observe a treetop frequently when felling, even if you think you know where it will fall. Expert woodsmen have been crushed.

NATURAL SURVIVAL FOODS

ANTARCTIC

Seals and penguins are the most readily available sources of local food and fuel, and may have to be used for survival, although these animals (and fish) usually suffer worm infestations of various types.

Penguins may be most easily killed by squashing the air out of their lungs for a fairly long period by sitting on them. Penguin stew or grill is palatable and goose-like in texture and taste, if the external fat is removed before cooking. Penguin liver is excellent.

Fresh eggs are obtained by moving all eggs from a marked area, followed by daily "harvesting" of the marked area. Penguin eggs are tastiest scrambled (the albumin solidifies on cooking, but does not turn white like the periphery of a "sunnyside-up" chicken's egg.) Five minutes of boiling hardens a penguin egg.

Skua breast makes a good stew. (Skin off all fat--it's fishy.)

Hit seals between the eyes with the pick of an ice axe, and then cut their throats. (For dog food, DON'T cut the seal's throat. Blood is good dog food.) The crab-eater seal is the tastiest, but all are edible--roast, grill or broil. Loin, tongue and heart are the tenderest muscles. Seal liver is a delicacy, but is particularly likely to be infested with parasites. The British find seal brain very good.

The nicethidae (small ball bat-shaped fish) may be caught in nets baited with bony or visceral scraps of bird or seal. They are a challenge lure-wise to the angler. The meat is soft and sweet like rock cod.

The fat of both Antarctic animals and birds isn't too tasty, but it is an invaluable source of fuel, albeit it is most fishy for eating, and most sooty in burning.

The exploits of Scott, Shackleton, Mawson and their crews show that with good headwork, willing spirit, and hard work, ill-equipped men can survive on the periphery of Antarctica through what appeared insurmountable circumstances.

ARCTIC

Native or Sourdough Items

Old timers of the north mention many interesting Eskimo, Indian and Siberian foods. "Pemmican" in one locale is meat of bear, seal, caribou and walrus mixed together with fish eggs and dried into a hard frozen block. Trappers "peaches and cream" is chewing dried beaver tail. Caribou back fat is better than chewing gum. Don't overlook the contents of a seal's stomach for a fresh fried fish dinner, nor the contents of a caribou's stomach (mixed with the tripe lining) as a tasty "salad" of reindeer moss and lichens, properly acidulated.

Walrus milked at death gives 16 quarts of milk, and when milked an hour or so later will give almost the same volume. It is rich and most nourishing. Hump of the bull walrus is considered by some the choicest meat of the north. Shark, seal and polar bear liver is said to contain toxic amounts of Vitamin A, yet Stefansson says he got sick eating the latter only when he ate too much at one sitting. Fish cheeks are delightful fried, and the boiled head and backbone make excellent soup! High fish takes the place of Roquefort cheese, birds pickled in fat are eaten whole. You won't be too fastidious when you get hungry enough!

Procurement

Any animal which can be shot or caught in the Far North is edible, and all except the relatively fatless rabbit will sustain life indefinitely if taken in sufficient quantity. Without firearms, snares of various types "strangle and dangle"--deadfalls "smash and bash."

Squirrel snares are loops of small snare wire tied as indicated on a limb where you've seen squirrels run. Head in the loop tightens, throws off balance, and he strangles with his own weight.

On traveled trails with recent rabbit "tracks," snares are placed in constricted places or the path is fenced to a narrow spot. This may catch rabbits, and possibly lynx or fox that prey on rabbits and use their trails. Essentials of any snare are:

1. Wire slip knot placed so the head will go through.
2. Trigger release.
3. Force for sudden pull on the loop's fixed end.

Automatic deadfall requires (1) bait to trigger release, and (2) force to move support of heavy rock or log. Hunter may pull the support, but his presence has a tendency to scare game away, and its rather tedious and frustrating at best. If you hear a snared rabbit whistle or a deadfall crash in the middle of a very cold night, get up and visit your lure before (a) a predator eats it, or (b) it

freezes so solid it will take hours to clean and cook.

Birds

Any bird, even hawks and owls, are edible. Seagulls may be caught with hook, line and bait. Grouse, partridge and ptarmigan may be killed with stones. Eggs are edible no matter where found or degree of hatching.

Fish

Fishing requires lures, monofilament line, patience and luck, unless the salmon are running, when they may be clubbed or caught with the hands in shallow streams. (Remember bears are doing the same thing.) Steelhead; Arctic char; Dolly Varden, grayling and rainbow trout; sockeye, king, pink and silver salmon; all are to be found in inland rivers and lakes.

On the coast of Alaska and its islands, Dungeness and rarely King crab may be taken in shallow water, occasionally by hook and line--more often in a net baited with animal, fish or bird viscera. Flounder and sea bass love to bite on piling worms and rock slugs. Herring like anything, but they're hard to get at without a boat.

Shellfish

Sea urchins, limpets, abalone, sand dollars, squid and octopi make good soup with some meat (often TOUGH!) Clams and mussels are also plentiful on Alaskan coasts and the Aleutians, but should not be eaten in the "R-less" months without caution. (The same applies to oysters on the Pacific Coast). When red (pink to orange) tides occur, these mollusks accumulate "gonyaulax," an extremely toxic micro-organism.

Natives have shunned the clams and mussels of the Ketchikan and Sitka area since 1790 when 700 Baranof Company Aleuts were paralyzed and 150 died following a "clambake." In spite of public warnings by California, Washington and Alaska health authorities, at least 268 cases of paralysis, with 17 deaths, have occurred on these coasts the past 40 years.

Symptoms following eating of infected mollusks are tingling of the lips and extremities, followed by general paralysis and death from respiratory failure. Treatment: Empty the stomach (if the patient hasn't already done so) and stand by for hours of artificial respiration. Iron lungs save lives here!

Plants

In general, almost all plants are edible. Young leaves and fern fronds make salad. Roots may be eaten raw or boiled. If you observe an animal eat it, it's safe.

If starving and in doubt, try a little; an hour later, try some more; after a 24-hour period if not physically ill, eat all you like or can find.

DON'T EAT MUSHROOMS. There's not a "calorie in a barrelfull," and the possibility of eating a poisonous toadstool is too great.

AVOID WILD CELERY for it may be confused with the poisonous water hemlocks which grow in marshy areas over inland Alaska.

All berries within the Arctic are edible. Rose hips, blueberries, gooseberries, currants, elderberries, bear berries, crow berries, kinni-kinic, raspberries, blackberries, cloud or salmon berries, are somewhat nourishing and fight off scurvy. In the summer of 1961 a man survived in the Brooks Range country for 65 days on berries and small game he could catch while walking back several hundred miles from a plane crash.

SURVIVAL COOKING

1. Cooking "twist" or shishkabob style on a stick, roasting in mud, steaming with coals or hot rocks, or boiling in makeshift pot with hot rocks may be done in extremes, but the results are usually palatable only to ravenous young Scouts on a two-day outing. If these methods are necessary, always cook with fat side up or fat on top of meat so it may seep into the meat while cooking. Salmon is cooked skin side up, so the fat trickles through.

2. Contrary to popular opinion and practice, a one-half gallon aluminum pot or kettle, NOT the frying pan, is the most important outdoor cooking implement in polar survival cooking.

3. Aluminum foil cooking is recently popular for broiling, frying or baking. Inner regular foil package covered with outer heavy duty foil may be surrounded in a bed of coals. Meat or fish (with fat or cooking oils) will be tasty in 15 minutes to an hour. Sliced or diced vegetables with additional water in the inner foil package cook in 15-30 minutes. Bread or biscuits may be baked in large foil packages at the side of the fire for 20-25 minutes, with the last 3-5 minutes buried in the coals. NOTE: It is virtually impossible to melt ice or snow in an aluminum foil dish or pan. Better carry the pot or kettle.

DO'S and DON'T'S

1. Always drink the water in which game or fish have been brought to a boil. Its nourishing, contains the water-soluble vitamins, and you need the water.

2. Cooking meat "rare" or "underdone" preserves more vitamins, particularly Vitamin C. Cooking meat well done is more likely to prevent trichinosis

or other parasitic infestation.

3. Bringing questionable foods to a bubbly boil destroys the toxin of botulinus.

4. DON'T throw away meat with rancid fat--it may offend a little, but it won't hurt you a bit. Don't throw away cheese or meat, and particularly smoked meats (sausages, ham, bacon), because of green mold. Wash it off--you probably can use the penicillin anyway! (You eat Roquefort cheese, don't you?)

5. If fortunate enough to get a free survival meal or two from Eskimos or northern Indians, don't turn up your nose at their hospitality. It may look awful and smell worse to the dilettante or gourmet, but if they can eat and enjoy it, so can you.

(See also pages 49 and 139 (TRAIL COOKING))

SURVIVAL RATIONS
or
TRAIL RATIONS FOR SLEDGING OPERATIONS

The designer of survival and trail rations endeavors to make the ration as light, as small in volume, as high in calories, as tasty, as healthful and as non-perishable as possible.

Using the Recommended Dietary allowances of the National Academy of Sciences and National Research Council (1958) the 6'2" man of maximum allowable weight 166 lbs. and 25 years of age was used rather than the 5'6", 154 lbs. man of dietary fiction. Bigger men go to the poles. The above big man at 20°C, with moderate physical activity needs 3,850 calories.

From 20°C down to 10°C he needs another = 5%
From 10°C down to -40°C he needs 3% for each 10°C = 15%) 20% -770 calories.

The dietary tables show average figures for food content and do not allow for poor crop years losses by processing, etc., so an extra safety factor was added ---------- + 10% = $\frac{385}{5005}$ calories

This should be sufficient for this large man to work on the trail 8 hours per day at temperatures down to -40°C without weight loss providing he gets adequate comfortable sleep, and providing he maintains perfect clothing routine so that he never sweats, and is not chilled too often, too hard, or too long. (This is difficult to do in cold weather for there are few routine jobs at which a pace may be set in polar regions. Uphill one sweats, downhill one chills.) To be safe one learns to stay almost too cool for comfort indoors or out and this necessitates more body fuel.

Many calculate diets from tables in the metric system using 30 grams/ounce (precisely 31.0103 g/oz) correcting to the laboratory apothecary (Troy) weight with which they are familiar. Foodstuffs for expeditions, however, are purchased by the avoirdupois pound with the equivalent of 28.36 grams/ounce. This explains why the following rations show lower calorie/ounce ratios, for study has shown apothecary equivalents to have been used in their original calculations.

There are almost as many variations of menus, as many types of pemmican as many differing ideas in what a man needs or should have as there have been men who have seriously studied cold weather nutrition and survival. Following are some sample daily rations with remarks deemed necessary for guidance of those interested.

U.S. Antarctic Service (Harrie - 1939)			Danna Coman 1943			U.S. Forest Ranger Winter Ration (1952)		
Wt. (oz)	Item	Calories	Wt. (oz)	Item	Calories	Wt. (oz)	Item	Calories
19	Pemmican[1]	1670	12	Pemmican	2010	8	Bacon	1376
1	Bacon[2]	172	1	Bacon	172	4	Cheddar Cheese[2]	456
2/4	Cocoa	63	3/4	Cocoa	63	3	Powdered Milk	309
4	Powdered Milk	412	4	Powdered Milk	412	4	Salted Crackers	480
5	Biscuit[4]	690	6	Biscuit	720	4	Rolled Oats	380
2	Cereal[5]	230	2-1/2	Oatmeal	279	8	Dried Fruit[6]	660
1	Dried Fruit[6]	75	1	Dried Fruit[6]	75	4	Butter (optional)	812
2	Butter	406	2	Butter	406	4	Milk Chocolate	552
1	Mixed nuts	176	1	Mixed nuts	176	4	Sugar	436
3	Milk chocolate	486	4	Milk chocolate	570	2-6	Bouillion cubes	26-84
4	Sugar	436	2	Sugar	218	1/2	Tea bags 6	24
1/4	Lemon Powder	35	3/4	Lemon Powder	105	1	Salt	
1/4	Salt		1/10	Salt				
One Fat Sol Vitamin Caps A. 20,000 I.U. D. 2,000 I.U. E. Wheat Germ Conc. Two Water Sol Vitamin Caps Totaling B_1 1/6 mg B Complex amt. unknown C - 50 mg Iron - 24 mgm			One Fat Sol Vitamin Caps A. 20,000 I.U. D. 2,000 I.U. E. Wheat Germ Conc. Two Water Sol Vitamin Caps Totaling B_1 1.6 mg B Complex amt. unknown C - 50 mg Iron - [illegible] mgm				
Harris 34-1/4 oz - 4761 Cal 138 Cal/ounce			Coman 37 oz - 5206 Cal 140 Cal/ounce			40 oz - 4590 Cal to 4402-5458 Cal 114-129 Cal/ounce		

Deep Freeze II (1956) Modified Army Ski Ration

Wt. (oz)	Item	Calories
16	Pemmican	2720
3	Cocoa	250
3-1/2	Sea Biscuit	560
3	Cereal Bar	360
4	Fruit Cake[7]	460
3-1/2	Mixed Candy	500
2	Chocolate	285
3	Sugar	327
1-1/2	Potato Soup	60
1/4	Dehydrated onions	10
2	Beverage Packet containing:	
	Soup & Gravy Base	
	Chill Seasoning	
	Lemon Drink Powder	
	Instant Coffee, 2 [11]	
	Soluble tea, 2	
	Dry Cream, 4	
	Sugar, 1/5 oz., 4	

Therapeutic Multiple Vitamin-Mineral Capsule[12]

41-1/2 ounces - 5800 Calories

140 Calories/ounce

New Zealand Trail Ration per Man per Day (1959)

Wt. (oz)	Item		Calories
6.4	"Meat Bar"		1000
1.6	Bacon[2]	(291)*	275
.8	Cocoa	(83)*	66
.8	Cheese	(203)*	90
2	Powdered Milk	(300)*	205
4	Biscuit		488
2.4	Rolled Oats		224
.8	Raisins	(112)*	61
3.6	Butter	(657)*	732
4	Milk Chocolate	(535)*	570
4.8	Sugar	(524)*	514
1.6	Potato Powder		160
.8	Powdered Egg		138

Powdered Soups, Coffee & Tea, Vegamite, Salt, Marmalade & Jam[14], Fruit Cake [7], Lemon Powder) Varied with taste & Length of Trip

34 ounces - 4519 (4800)
134 (191)* Calories/ounce

*N.Z. estimate

Australian Trail Ration per Man per day (1960)

Wt. (oz)	Item		Calories
8	Pemmican (1)		1272
1	Cocoa	(126)*	83
2-1/2	Powdered Milk		256
5	Biscuit	(662)*	611
2	Rolled Oats	(228)*	224
4	Butter	(972)*	812
1.5	Potato Powder		157
2	Milk Chocolate	(310)*	285
4	Sugar	(448)*	436
1	Powdered egg		168
1/3	Onion dehydrated		28
1/3	Coffee		
1/6	Vegamite		
1/6	Salt		
	Multiple Vitamin Cap		

32 ounces - 4432 (4841)*
139 (151)* Cal/ounce

* Australian Estimate (15)

RECOMMENDED POLAR RATION

Wt. (oz)	Item	Calories Per oz.	Total Calories	% Protein	% Fat	% Carbo.	%Fiber, Water, Ash
8	Pemmican(1)	170	1360	47	44	0	9
2	Bacon(2)	172	344	25	55	1	19
1	Breakfast Cocoa	83	83	8	24	49	19
2	Pwd Skim Milk	103	206	36	1	52	11
4	Biscuit(4)	123	492	8	9.6	70	8
2	Cereal(5)	120	240	13	4	72	11
2	Dried Fruit(6)	75	150	3	1	70	26
2-1/2	Butter	203	570	.6	81	.4	18
2	Honey P-Nut Butter(8) or mixed Nuts	160-176	320-352	17	58	18	7
4	Milk Chocolate	138	552	6	33.5	56	4.5
3	Sugar	109	218	0	0	99.5	0.5
1	Powdered Egg	168	168	47	42	2.5	8.5
1	Rice(13)	102	102	7.6	0.3	79.4	0.2
2-1/2	Beverage Packet 2-4 Bouillon Cubes(9) 1/2 oz Lemon Drink Powder Spices (10) 2 Instant Coffee(11) 2 Soluble Tea 6 Dry Cream 1/4 oz Salt 1 Therapeutic Multiple-Vitamin-Mineral Capsules(12)	252	20	45	20	15	

37 ounces - 4994 - 5026 cal.
135 calories/ounce

Polar Trail Rations

Expedition	Ration wt. (oz)	Calories	Ratio P: Fat: COH
Watkins 1930	39.4	6000	1:1.4:1.5
Byrd II 1934	37.5	5500	1:1.8:2.8
Rymill 1935-36	25.9	4000	1:2.0:2.2
Harris 1939	34.2	4760	1:1.8:2.6
Coman 1943	37	5200	1:2.1:2.9
Deep Freeze 1956	41.5	5800	1:1.1:1.8
Ranger 1958	42 (Ave.)	5024	Varies
NZ Ant. 1959	34	4520	1:1.7:2.7
Aust Bat. 1960	32	4432	1:1.5:1.7
Recommended 1961	37	5000	1:1.5:2.0

1. Pemmican

True pemmican is the lightest, most complete single food, and most satisfying food for survival or trail operations. Made right it tastes good. It should be 50% by weight of powdered vacuum dried UNCOOKED beef, venison, moose, elk (not pork) mixed with 50% by weight of kidney fat (suet) from the same animals. Stefansson proves that this was the mainstay in the diet of early plainsmen, mountain men, and the early American fur trade in the Great Lakes and Canadian areas. Man can live on meat and fat alone if he has to, but not on pemmican alone for it contains too high a percentage of fat over protein.

Pemmican was first adulterated by berries in the hope of allaying scurvy. (Raw, rare, or underdone meat alone is anti-scorbutic. The well fed Eskimo on meat, fish and fat ONLY never developed scurvy. Shackleton, Scott and other Antarctic explorers cured scurvy in their men with fresh seal meat, although they didn't know why.) This adulteration continued to the point where "pemmican" contained chocolate, raisins, fishmeal, vegetables, etc. This became most ridiculous in a World War II survival "candy bar" of suet, oleo oil, raisins, dried apples, crisp bacon, peanuts, dextrose, coconut, vanilla, and salt being called "pemmican."

COMAN Pemmican Formula (1949)

Beef Suet	32%	Iodized Salt	.8%
Dry beef liver	12%	Spices	
Soy bean flour	4%	Black pepper	.1%
Whole powdered milk	30%	Cayenne pepper	.025%
Dehydrated pea & lima bean soup	5%	Ginger	.025%
Dehydrated potatoes	8%	Thyme	.0125%
Derbetain Veg. Conc.(Tomato Soup)	8%	Brewer's yeast	.0375%

Protein 22% Fat 42% Carbohydrate 30% Calories 167.5 ounce

Not even the trail dogs would eat this liver flavored vegetable bar on Deep Freeze I. British on F.I.D.S. who worked with an American Expedition in the Palmer Peninsula in the 1940's found that trail parties using it developed incapacitating diarrheas.

HARRIS Pemmidan Formula (1939)

Fortified whole cereal	25%
Cooked dry beef liver	5%
Dehydrated dry beef	30%
Vegetable concentrate	10%
Margarine	30%

Protein 27% Fat 42% COH 20%
Calories 173/ounce

This was a step in the right direction, but to our knowledge it was never used.

U.S. Meat Food Product Bar (194? - 195?)

Made by U.S. Army Q.M. Corps

Type I		
Cooked Dried Beef	50 parts	Fat 42-47%
Cooked Dried Pork	50 parts	Protein 43-52%
Salt	2 parts	Moisture 4-8%
		Inorganic 2%

Type II	
Above + 3/8 parts ground sage	172-194 cal/ounce

The meats in this bar are cooked (destroying virtually all vitamins B and C) ground, and dried by heat vacuum or heat atmospheric dehydration. The fat content is adjusted with oleo stock of 45°-49°C. melting point.

This was definitely a step in the right direction. This product is tasty raw, (instead of, and more satisfying than a candy bar) cooked as meat patty or hash, or in more water as a soup or thicker trail "hoosh." Its acceptance proves that the "All American Boy" will eat Pemmican so long as it is labeled "meat bar."

Meat Bar (New Zealand - 1959)

Made by Ministry of Agriculture, Fisheries, and Food; Aberdeen, Scotland.

Cooked Dry Beef	50 parts	Fat	40%
Cooked Dry Pork	50 parts	Protein	51.3%
Salt	.75 parts	Moisture	7.5%
Monosodium glutamate	.50 parts	Inorganic	1.2%
		160-175 calories/ounce	

This product differs from the U.S. Meat Bar in having less salt (preferable), addition of "Accent," in slightly lower fat content (preferable), in the fact that the cooked meat is diced or minced rather than ground (explorers prefer this), the meat is frozen vacuum dried (much to be preferred, and this would be ideal if the meat were all beef and not cooked to start with), and the fat content is adjusted with beef suet (excellent) and lard (unfortunately hog fat contains no vitamin A and becomes rancid more quickly than beef suet). The fat is said not to separate out as readily when cooked and over all it seems superior to the USA Q.M.C. product.

2. Bacon

Canadian bacon (65 cal/ounce) or a smoked side are preferred to the very salty canned bacon (175 cal/ounce). These are used as "hoosh" flavoring or with the powdered egg in making omelet.

3. Cheese

Not only is cheese constipating but it freezes and powders in extreme cold becoming unsuitable for any use except cooking.

4. Biscuits

Biscuits should be a whole grain mixture for needed roughage and vitamins rather than white flour "soda crackers, " which are friable, take up excess space, and when salted, increase thirst. Following is an excellent recipe for a cracker which is tasty and has the approximate consistency of Scandinavian rye crisp. This make about 22 ounces of good eating.

Trail Biscuit

White wheat flour	4 ounces	Sift dry ingredients together. Mix honey
Whole wheat flour	3 ounces	oil, egg, and water. Combine. Roll like
Wheat germ flour	3 ounces	pie crust. Cut with square cookie cutter.
Buckwheat flour (a)	3 ounces	Bake 40 minutes at 250°F.
Whole cornmeal	3 ounces	(a) added for rutin content
Honey	7-1/2 oz.	(b) corn oil, soy bean, or cotton seed in
Cooking oil (b)	2	that order of preference
Salt	1	
Baking powder	1/2	Prot. 8%, Fat 9.5%, Carbohydrate 70%
Water	4	123 calories/ounce
Egg	1	

5. Cereal

Cereal should be whole grain cereals, wheat, oats, corn, barley, etc. and should be varied. (One man on a long field trip almost starved because he became allergic to oatmeal, the only cereal carried.) Precooked cereals save time and fuel on the trail.

6. Dried Fruits

Dates, prunes, raisins, figs, apricots, peaches, apples, mixed or varied day by day. These vary in calories between prunes (65 cal/ounce) to dates (80 cal/ounce). Munched on the trail they keep the explorer preoccupied, making time pass and they do not cause the dental trouble usual with candy. Stewed for breakfast they are excellent.

7. Fruit Cake and Candy

These delight the sweet toothed American and sledgers on the move because they do not freeze too solid. These items, however, firmly stick concentrated sugar between the teeth, causing accelerated tooth decay. Extra cereal or pemmican bar may be substituted for these items.

8. Honey Peanut Butter

(Contains palatable whole yeast). May be varied with equivalent of other nuts, mixed or varied.

9. Bouillon Cubes

Make for many men the most satisfying and thirst quenching hot drink. They can be used in many ways in cooking.

10. Spices

To overcome the monotony of pemmican every day over long periods varying 1/4 ounce packets may be made up with the following flavors to be added to the pemmican-water "Hoosh" mixture.

a. 1/3 onion, 1/3 garlic, 1/3 paprika (Greek)
b. Curry 1/2, onion 3/16, celery 1/4, garlic 1/16 (Hindu)
c. Chili 3/4, paprika 1/4 (Mexican)
d. Bay 1/2, onion 1/4, paprika 1/4 (Scandinavian)
e. Celery 1/2, sage 1/2 (American Turkey dressing)
f. Sugar 3/4, hickory smoke salt 1/4 (American sugar-smoke)
g. Onion 1/2, saffron 1/16, paprika 7/16 (Spanish)
h. Tomato 1/2, oregano 1/4, paprika 3/16, garlic 1/16 (Italian)

11. Coffee

Instant coffee should be caffeine free.

12. To the author's knowledge, "Biopolmin," by Biopharmaceuticals Oreg. Inc., Warrenton, Oregon, is the best in a large field of similar products.

13. Rice

Rice is light and easy to use. Should be "minute" precooked to minimize cooking time. May be added to "hoosh" or soup. With raisins or other fruit, sugar, egg, and milk makes excellent dessert. Just boiled it's kept many an oriental alive and fighting.

14. Jellies & Jams

Of all sweet bread spreads orange marmalade is probably best for it contains some vitamin C, but it also contains the flavonoid hesperidine (see Nutrition).

15. The Australian ration is packed in 12 man-day units to facilitate division by 2, 3 or 4 man parties. Butter is tinned, pemmican doesn't need to be. Other items are put in polyethylene bags and then packed in a calico (cotton-nylon would be more wear and tear resistant) bag sprayed with water proofing compound. This is much lighter and practical than the American individual and mass cardboard cartons, each with water-proof cover, which add almost 20% to weight of each ration. Cans should be avoided for they are excess weight, opening often produces lacerations, contents are hard to thaw and remove, and when frozen, cans stick to warm fingers.

FREEZE-DRIED FOODS

Recently developed dehydrated foods (whole menus) are tasty, require minimal cooking, and are about half the weight (though nearly double the volume) of concentrated survival foods. They are most handy for hunting or backpack camping trips. Unfortunately, they are expensive.

TRAIL COOKING

1. Always cook inside shelter from wind or inside tent, but if in tent or snow shelter, ASSURE ADEQUATE VENTILATION.

2. DON'T BOIL rations protractedly in a tent; it will very quickly hoarfrost the inside of the tent at subfreezing temperatures. Bring to a boil, then put aside in as warm a place as possible and allow hot water to cook food till cool enough to eat. This saves fuel, too!

3. Breakfast--moderate in energy, but fat enough to satisfy.

Bacon	1 oz.	Butter (in cereal)	1/2 oz.
Egg	1 oz.	Fruit	1/2 oz.
Cereal	2 oz.	Coffee & Cream	
Milk (Cream)	2 oz.	Sugar	1-1/2 oz.

Lunch--noon halt. High carbohydrate, minimum preparation.

Biscuit	2 oz.	Nuts	2 oz.
Butter	1 oz.	Lemonade & sugar	1 oz.
Fruit	1-1/2 oz.	or bouillon made at breakfast,	
Chocolate	4 oz.	kept fluid in thermos	

Supper--high protein and calorie meal giving warmth and tissue repair during night's sleep

Pemmican	8 oz.	Rice	1 oz.
Bacon	1 oz.	Cocoa	1 oz.
Biscuit	2 oz.	& Sugar	1/2 oz.
Butter	1 oz.	& Cream	

This is only a suggested variation of menu for the "ideal" ration. It may be juggled in any way the traveler's culinary fancy directs, but the big meal is at bedtime.

(See also pages 49 and 130 (SURVIVAL COOKING))

INDIVIDUAL CAMPING EQUIPMENT

This is not a foolproof kit, but should form a fairly complete list from which items may be deleted, depending on terrain, weather, time expected away, nearness of search and rescue facilities, etc. The items are given in order of usual relative importance. It is recommended that every man carry a commodious rucksack or backpack (pack boards with duffle bag allow packing with higher and further forward center of gravity, making walking easier with pack) to carry the following:

1. Clothing. Wear or carry a complete set of clothing suitable for possible weather conditions to be encountered. (See CLOTHING). In addition, the rucksack should contain at least:

a. One complete change of socks (and/or bootees) and innerliners or innersoles.
b. Extra pair of dry gloves.
c. At least two big bandana handkerchiefs.
d. Change of shorts and undershirt.
e. Whiskbroom to keep snow off boots and clothing to keep them dry inside shelter. (If not packed with the survival tent.)
f. In Arctic - head net and leather gloves vs. insects.

2. Sleeping Bag (down only). The "Fairy Down" sleeping bags from New Zealand are probably the most for the money. The bag should be used on an air mattress for maximum comfort and insulation efficiency with a blanket of polyvinyl foam between. (See SLEEPING BAGS, p. 41.)

3. Food. This has been covered in a previous section and will be mentioned in the following section on survival gear for parties in aircraft or vehicles.

4. Heat - Stove and Fuel. Kerosene, gasoline or alcohol pressure "Primus" stove (in order of preference) with one quart per day per stove minimum fuel. Plus following accessories:

a. Waterproof matches in waterproof match case. Plastic case with flint on side or end is preferable. Cut matches in half and the case will hold twice as many. A foolproof lighter requires extra fuel, flints and wick.
b. Eight candles per man or one candle per tent per day for sledging (in plastic bag).
c. Nest of two-quart-size pots containing a cup and spoon per man. As boiling point goes down with increase in altitude, a small pressure cooker may be indicated to save fuel for parties above five to ten thousand feet. Sea level cooking time is doubled at 5,000 feet.

d. "Meta" tablets for starting primus stove.

e. Quart thermos bottle per man (on Antarctic trail).

f. Quart canteen with cup and cover. In Arctic regions canteens have been used as hot water bottles. Inside clothing they provide ready drink. They freeze readily, but may be thawed on a stove.

5. Communications

a. Mirror, signalling, with built-in sights.
b. Whistle
c. Notebook or diary and pencils.

6. Miscellaneous

a. Swiss officer's (super Boy Scout) knife
b. First aid equipment - more or less
(1) 10-20 aspirin
(2) Iodine or merthiolate
(3) Chapstick
(4) 6 band-aids
(5) Antibiotic pills
(6) Sterile compress
(7) Cl or I water purification pills
(8) Burn ointment
c. Compass, charts showing area compass variation, and logbook.
d. Tools -- small flat file, whetstone, variable bit screwdriver, pliers, small scissors, 4 to 10 diopter lens, etc.
e. Facial-type toilet paper.
f. Extra spectacles (plastic frames and lenses in crush-proof case).
g. Extra sunglasses or slit survival goggles.
h. Small sewing kit with #30 or "heavy duty" thread with six needles in three sizes; thimble; safety pins. For sledging, sailmaker's palm, needle, twine, and tent material.
i. Toothbrush and fluoride-containing toothpaste.
j. Bar of mild soap ("Ivory" or "White Swan".)
k. Two or more lengths of small line, long shoe strings, thongs, etc.

7. Optional

a. Hunting knife
b. Binoculars
c. Tent
d. Hand axe
e. Shovel (trenching spade)
f. Small bath towel (or excess of absorbent paper)
g. Flask of brandy, vodka, or preferably 95% ethyl alcohol
h. Tobacco
i. Flashlight with extra batteries

8. If our polar traveler can still walk with the above pack, for greater enjoyment of the trip he might include:

a. A 35 mm. camera (preferably reflex) with 3-30 rolls of color film,

light meter, wide-angle and telephoto lenses, flash attachment, flash bulbs and photo handbook.

b. Paper-back book (on survival)

c. Cards or chess set

AVIATOR'S INDIVIDUAL KIT

ARCTIC AND ANTARCTIC

1. Swiss officer's multi-purpose knife
2. Plastic match case with flint, filled with:
3. Half-length water-proofed "kitchen" matches
4. Signal mirror
5. Compass
6. Candles, 6", 2-3
7. Oxytetracycline tables 4 gr. 16-24
8. Triangular file
9. #14 and #16 sailmaker's needle
10. Chapstick
11. Band-aids - 6
12. Change of wool socks
13. Small bar "Ivory" soap
14. Canteen cup or small po

ARCTIC ONLY

1. Mosquito repellent.
2. Snare wire: 50-100 ft. of stainless steel or annealed brass
3. Fishing kit
   a. Fish line - 100-200 ft. 30-40 pound monofilament line
   b. Hooks - 2-3 #1, #5 and #8
   *c. Spinners - 1-2 each of:
      (1) 2-0 or 3-0 "Colorado" or "Indiana" with treble hooks
      (2) -0 and 00 (small) "Meps"
      (3) Smallest "Daredevils" up to 1" in length
      (4) 501, 502, 503 Silver "Superduper"
   d. Assorted weights
4. 18"-24" wire "Gigli" saw
5. 3"-6" of red, yellow orange, pink, chartreuse yarn for fish and bird lures

ANTARCTIC ONLY (ARCTIC OCEAN)

1. Small "primus" kerosene stove with fuel
2. #1 survival ration, 2-3
3. #2 survival ration, 3-5 (3 pemmican bars each)

*The author is the "unluckiest" fisherman alive, but on these spinners (in order of personal preference), he has caught fish in Alaska when others went empty-handed.

GROUP SURVIVAL GEAR

Some expeditions carry common stores for all hands at all times. With many inexperienced in what might be needed, e.g., "tourists" aboard aircraft, this is the safest policy as far as the pilot is concerned. All group survival gear, first aid kits, food, fuel, extra clothing, tentage, signalling gear, etc., should be split, particularly on large aircraft, between forward stations and tail section to assure salvage of a representative part of each type of gear in case of crash with destruction of one or the other end of the plane. One ingenious and well-equipped individual in the party might have enough miscellaneous equipment (see INDIVIDUAL SURVIVAL GEAR) to satisfy the needs of quite a large group, with the exception of the following:

1. Heat - stoves - one kerosene or gasoline "primus" for every three men or fraction thereof, depending on type of fuel the plane uses.

2. Food - seven to thirty days of the survival ration for each man, depending on length of flight, type of flight, terrain to be covered, search and rescue or support capabilities, etc. With survivors "hibernating" in their sleeping bags when not on duty, leaving only necessary men on watch to cook, communicate, etc., the food might be stretched out two, three, or four times as long as calculated and life still be maintained. But if a few must care for many injured, and perhaps man-haul them some distance, only the full ration will long maintain the weight of a working 180-lb. man.

3. Cooking gear - quart pot/2-4 men; cup and spoon each

4. Shelter (a parachute will serve one or two men)

   a. Two-men tents as necessary (with mosquito protection in the Arctic)
   b. One snow knife per three men
   c. One shovel per tent
   d. One snow saw per plane or vehicle

   } For making snow shelters

5. Communications

   a. Radio:

   (1) SCR-578-B "Gibson Girl" - automatic SOS or Key "CW" transmission on 500 KC, range 100 miles with kite, hand-powered generator. (Obsolete, but may be found at remote locations.)

   (2) AN/CRT-3 500 KC ----- 8280 KC) Modified "Gibson Girl" -
   AN/CRT-3A 500 KC ----- 5364 KC) range up to 600+ miles with kitoons and/or kite, and ground wires (on barrier) of optimum length (1/4 wave length or 29'4" for 8364 KC). This transmits SOS automatically on alternate wave lengths, and on 500 KC only can be keyed for CW with a tone-modulated signal.

(3) New Zealand sledge parties have successfully used a "557" Radio, made by Collier and Beale of Willis St., Wellington, N.Z. This radio powered by dry cells transmits on CW consistently 1000 miles. Weight 60 lbs. With optimal transisterized R.T. attachment an additional 11 lbs.

(4) "Walkie-Talkie" portable battery voice radios (distress frequencies must be predetermined and monitored).

(a) AN/TRC-6 (miniature) 47-55.4 megacycles - range 1 mi.

(b) AN/TRC-17 121.5 - 243 megacycles - range 7-15 mi. overland and 15-30 miles over water from aircraft at 5,000 feet altitude.

(c) "Commando" - British Army radio - wt. 15 lbs. Good on CW 300 miles and on voice about 100 miles.

b. Black or red smoke grenades, or 10-minute railway fuses

c. Panels, 2 per plane (wrap survival gear in these)

d. Binoculars (2 per plane)

e. Battery lantern flash lights (except during summer operations)

f. 50 to 500 red and/or orange trail flags with split bamboo poles.

6. Transportation (most of this equipment may be readied for search and rescue air drop to stranded parties depending on the operation):

a. At least two sets of skis per vehicle with poles, boots, harnesses. (Snow shoes are satisfactory for most of Arctic, but skis are mandatory in the Antarctic and on the Greenland Ice cap.)

b. At least one alpine ice axe per 3 men. Trail use 1 ice axe/man.

c. At least one 120-foot length of 7/16" nylon line.

d. At least two 120-foot lenghs of 5/8" hemp rope or terylene line.

e. Crampons - 2 pairs per party. Trail use - 1 pair/man and spares.

f. Snaphits - 3 to 6 per party. Trail use - 1 Karabiner/man plus body slings and foot loops.

g. Akja or man hauling sledge per 3 men with 3 harnesses per sled.

h. Sledge bags for food, equipment, supplies.

i. Sextant, chronometer, navigation tables.

j. Probing rod

k. Crevasse ladder

7. Arctic only

a. Mosquito repellent (summer only), and mosquito net.

b. Hand axe (25" handle) and 1 to 2 hatchets per party.

c. .300 magnum to .375 H & H magnum bolt action rifle with 20 to 100 rounds of soft point hunting ammunition. One to every 5 to 6 men or field party.

d. One 12-gauge shotgun with 25 to 50 rounds of #6 birdshot and 10 to 20 rounds of slug or heavy buckshot per party.

e. .44 Magnum or .45 caliber pistol with hand loaded 230 grain (at least) wadcutter ammunition. If service ammunition only is available, cut or file the last 1/8" from the steel (copper) jacket so that a pea-sized area of lead shows through the end. This "dum'dum" has increased killing power on bear or wolf. Range must be not over 15 yards to assure much accuracy for the average pistol

shooter. Keep your eye on the front sight and gently squeeze. In encounters such as these there is usually only one survivor.

8. Plane maintenance gear:

   a. Blow torch or "York" heater with fuel
   b. Engine cover
   c. Battens
   d. Tiedowns
   e. Ice anchors and lines
   f. Oil funnel, drain hose, container, chamois

9. Planes on over-water flights:

   a. Life rafts with "Gibson Girl," flash lights, dye markers, etc.
   b. Exposure suits, 1 per man
   c. Life jacket, 1 per man
   d. Parachutes are rare in Antarctica. Over most of the continent a crew bailing out without extensive survival gear would soon perish. Most flyers prefer to ditch their planes on the ice or snow and depend on rescuers finding them alive at the plane.

10. Search and Rescue Drops will include:

   a. Food, fuel, medicine, clothing as required
   b. Pararescue team with or without dogs as required
   c. Transportation equipment (5 above)

GROUND TO AIR CODE

The figures may be trampled in the snow, made with logs or tree branches, strips of parachute or other fabric, dirt or soot on snow, or snow on dark land. They should have high contrast, and must be at least 8-10 feet long to be readily visible from the air.

REQUIRE MAP & COMPASS

REQUIRE ARMS & AMMUNITION

REQUIRE SIGNAL LAMP

REQUIRE ENGINEER

AIRCRAFT BADLY DAMAGED

WILL ATTEMPT TAKE-OFF

UNABLE TO PROCEED

NOT UNDERSTOOD

BODY SIGNALS

USE DROP MESSAGE

REQUIRE MECHANICAL HELP OR PARTS

OUR RECEIVER OPERATING

CAN PROCEED, OR WAIT

PICK US UP AIRCRAFT ABANDONED

YES, AFFIRMATIVE

ALL WELL

NO, NEGATIVE

PANEL SIGNALS

Land(L) and Sea (S) use life-raft sail, on snow or ice use black and fluorescent red ground cloth panel.

NEED EQUIPMENT

YELLOW OR RED

BLUE OR BLACK

REQUIRE TOOLS

REQUIRE MEDICAL SUPPLIES

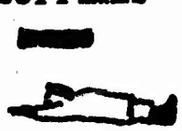
REQUIRE FOOD & WATER

REQUIRE FUEL & OIL

REQUIRE CLOTHING

WE PROCEED THIS DIRECTION

SHOW DIRECTION TO PROCEED

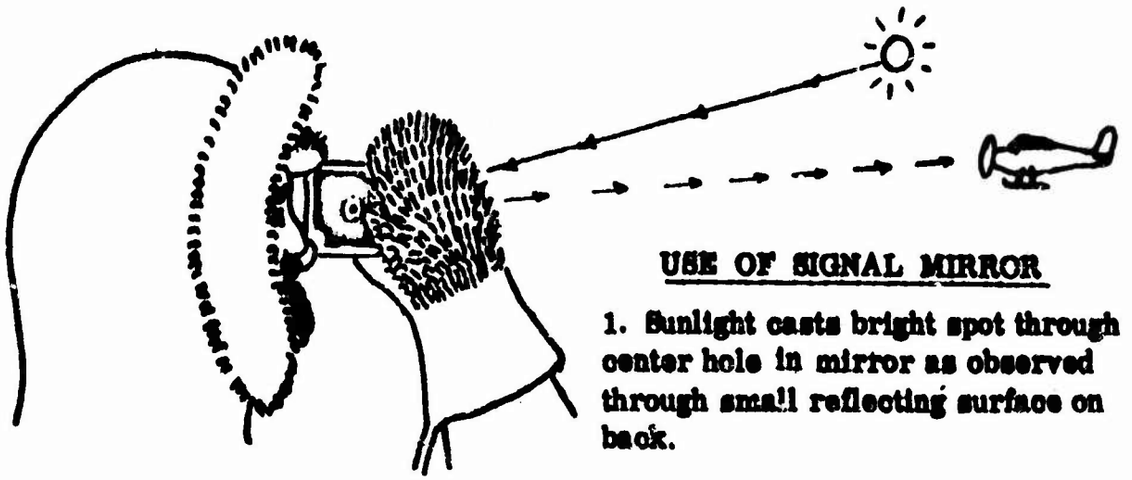


REQUIRE DOCTOR

LAND HERE, POINTING DIRECTION

DON'T LAND HERE

Aircraft acknowledges AFFIRMATIVE by rocking wings or GREEN flashing light.
NOT UNDERSTOOD acknowledged by complete circle to right and RED flashing light.



USE OF SIGNAL MIRROR

1. Sunlight casts bright spot through center hole in mirror as observed through small reflecting surface on back.

2. Adjust mirror until aircraft observed through center hole coincides with sunspot on face observed through rear mirror.

MORSE CODE

Radio, Telegraph, Sound, Light, Mirror, or Flag Wig-Wag

Dot Dash

A .-	E .	I ..	M --	Q --.-	U ..-	Y -.--
B -...	F ..-.	J .---	N -.	R .-.	V ...-	Z --..
C -.-.	G --.	K -.-	O ---	S ...	W .--	
D -..	H	L .-..	P .--.	T -	X -..-	

Opposites and Similes Aiding Memory

E .	T -	A .-	N -.
I ..	M --	U ..-	D -..
S ...	O ---	G --.	W .--
R .-.	K -.-	V ...-	B -...
P .--.	X -..-		J .---
F ..-.	L .-..	Q --.-	Y -.--

Numbers

1 .----	6 -....
2 ..---	7 --...
3 ...--	8 ---..
4 ....-	9 ----.
5	10 -----

Rote memory for C -.-. Z --.. H ....

Standard Procedure Signals

...---...S O S	HELP!!
.-.-.-.- (4 A's)*	I'LL SEND, YOU READY?
-.-.--.- (CQ)	ANSWER, ANYBODY!!
-.- (K)	GO AHEAD
..... (8 E's)	ERROR
..--..	Repeat Message

*(Below) Wig-Wag only

-	(T)* WORD RECEIVED
.-.	(R) MESSAGE REC'D
.-.-.-	(3 A's) PERIOD
Pause	WORD END
.-.-.	(AR)* MESS. END
-...-	(BT) MESS. END

POLAR DO'S AND DON'T'S

1. Dares are neither offered nor taken. Necessary risks are bad enough.

2. Study charts and aerial maps of an area before operating in it. Know the crevasse areas, the penguin rookeries, where seals congregate, where the ice melts, etc., then carry a working map.

3. Check out with the camp leader or commanding officer when you leave camp or ship. Let him know where you are going and when to expect you back, then stick to your itinerary if possible. Maintain a log of these movements in writing if on a protracted trip. (Be sure to check in when you return.)

4. When leaving camp or ship, regardless of means of transportation, be sure you are adequately dressed, properly equipped, have sleeping bag and sufficient rations to last out in the open three to ten days. If flying, make sure your survival gear is aboard the plane. You may be stranded or have to walk home.

5. Never leave camp alone - at least two men per party on sea ice or hiking on land. The buddy system not only helps in prevention and early treatment of frostbite, but if you fall into the water, your buddy's efforts will probably save you. If you break a leg you have assistance and someone who knows where you are to go for help.

6. On shelf ice or glacier ice, parties must consist of three or more men, and they must rope together if in questionable crevasse country. In crevasse country, trail breakers on skis must CONTINUALLY probe for crevasses with ice axes. In probing for tractor trail, longer, heavier probes (crowbars) must be used. Select camps on glacial ice with great care, and don't unrope except on thoroughly tested and marked areas.

7. Parties MUST stay together with no eager, single man ahead or a straggler or two at the rear. When away from camp, stay in recently marked trails or on recent vehicle tracks, but even this precaution is not always infallible.

8. If at all possible, there should be at least one experienced man with each party going ANYWHERE.

9. Snow or ice in motion, glaciers, ice shelves, and ice tongues invariably have crevasses. Avoid them at all cost unless there is NO other possible route.

10. Stay clear of top and bottom of ice cliffs, on barriers, glaciers and icebergs.

11. ALWAYS, whether in vehicle, on foot, or in the air, anticipate accidents and have a plan for survival. When the accident happens, work HARD and FAST.

12. Wear LEATHER gloves at ALL times when flying. They are indispensable to hand protection from fire during flight and after crash in case the plane burns. Hard hats or "bone domes" will be worn by all crewmen for all landings and take-offs.

13. If a plane crash is imminent, secure loose objects in the plane, belt and shoulder strap yourself securely and STAY THAT WAY until all plane motion stops.

14. If down in the wilderness STAY AT THE PLANE and conserve your strength and body heat. YOU WILL BE FOUND. As in good first aid, if you don't know WHAT to do, do NOTHING. Make yourself comfortable where you are, have faith, don't give up.

15. Under survival conditions, if you must move, if possible mark your trail with flags visible from the air and leave messages of your intentions at each camp behind you. When you camp and go to sleep, be sure your lair (if an igloo or only a hole in the snow) is well marked so searchers may find you.

16. If you feel cold, remember that exercise produces heat. A particularly good exercise is to tense both the extensors and flexors of the arms and legs at the same time. This produces heat without motion. However, don't overdo it. There is a limit to work that can be done safely, and some rest is required to avoid exhaustion and imminent danger of freezing.

17. Perspiration is dangerous because it predisposes to frostbite and freezing. Keep clothes dry internally and externally. Change and dry socks and innersoles at least daily (twice daily if on trail). Underdress rather than overdress.

18. Move slowly until the amount of energy available after necessary heat production is known. What are in temperate climates "normal" speeds, in the Antarctic may be exhausting and crippling and often cause sweating.

19. Clothing must be kept clean and free of oils or grease. Tie-ties on parkas, mukluks, etc., are put there to keep out snow and cold air, but they must not be tied so tight as to diminish circulation.

20. Do not wear shoe-mukluk or shoe-overshoe combinations. Under survival conditions you will lose a leg.

21. Shoes and socks in particular must not be tight. If you wear size nines but tens feel so good you always buy elevens, your Antarctic footwear should be size twelves and thirteens to allow motion of the toes and to give sufficient insulation. Do not wear too many socks unless they are each successively larger in

width as well as in length. (Socks which are too big give folds which cause pressure points and increased tendency to cold injury.) If your feet hurt, you are not hurt. When they STOP hurting, INVESTIGATE IMMEDIATELY, re-warm and exercise feet, until sensation returns. Change to dry socks and dry innersoles or grass if necessary.

22. Keep your windproof clothing available at all times.

23. Watch your footing - ashore and aboard ship - cold weather footwear does NOT have good traction and you can take a bad fall.

24. Hoods, goggles and face masks limit vision. Be alert to danger on all sides.

25. Heavy and bulky polar clothing makes you clumsy and prone to accidents from lack of normal agility. Plan NOT to have an accident.

26. Do not touch cold metal with moist, bare hands. If you should inadvertently stick a hand to cold metal, urinate on the metal to warm it and save some inches of skin. If you stick both hands, you'd better have a friend along.

27. Be careful in handling gasoline, kerosene or liquids other than water, for contact at cold temperatures will induce immediate frostbite. NEVER mouth-siphon these fluids if it can be avoided.

28. Protective glasses or goggles must be worn at ALL times during daylight hours outdoors, whether the sun is shining or it is overcast. On sunny days, in addition, the nose and cheeks may be lampblacked to prevent glare. Scratchy, teary, light-sensitive eyes indicate snowblindness, but there are no symptoms until the eyes have already been damaged. Snowblindness results in a loss of two to five days at best - at worst, snow-blind people hold up their trailmates with their helplessness, fall in crevasses, or become lost and freeze to death.

29. The use of Chapstick will prevent much painful chapping and sunburning of the lips.

30. Eat your full ration and all items offered. Take extra vitamins when available. Deficiency diseases are disabling and make you a liability to the expedition.

31. About three minutes without oxygen, three days without water, and three weeks without food have the same effect on man. Remember, hot drinks add actual warmth to survival food, and they help maintain water requirements. Cook survival rations with plenty of water. This makes them more palatable and far more digestible. Boiled foods are more digestible than fried foods, and the juice gives you vitamins, minerals and needed water. Don't boil any food longer than necessary, for this destroys vitamins.

32. Whether you eat regularly or not, be sure you take in AT LEAST ONE TO TWO quarts of water per day, and no more than one-third of this as coffee (which is dehydrating). The vast majority of common ailments are prevented and treated by forcing fluids. Eating snow excessively cools the mouth and teeth. MELT it and drink.

33. Avoid alcohol except in small quantities - a toddy at bedtime, an occasional cup of cheer, OK - but drunkenness in the cold can mean death.

34. DON'T breathe too deeply the exhilarating polar atmosphere, particularly at temperatures lower than -25°F., without a face mask of some sort.

35. Keep indoor temperatures at 64° to 68°F. You will be much healthier. Dormitories should be from 40° to 50°F. and adequately ventilated.

36. Temporal throbbing or headache, lassitude, giddiness, confusion or a feeling of exhilaration with or without increased reddening of the skin, mean impending carbon monoxide poisoning. Assure adequate ventilation in all spaces where petroleum products are source of heat or power.

37. All hands must be strictly warned NOT to sit in running weasel or jeep (to utilize the heater) during a blizzard. Carbon monoxide poisoning is a very real danger!

38. Don't sleep through fire or security watches. Make sure every building has two exits, and that neither exit is ever closed by drifted snow.

39. NEVER SMOKE in or near aircraft without the permission of the plane commander. Likewise, don't smoke in vehicles or living spaces which smell of gasoline, ether, or other volatile explosive liquids. Stay away completely from fuel "farms" or tanks stowing petroleum products. Fire is one of the greatest dangers in polar regions.

40. Remember sea and shelf ice can break up in a matter of minutes, due to ocean swells. Given a little wind or current, you will go to sea on your own private ice raft. Stay away from tidal cracks and ice edges. Give icebergs, headlands, and glacial fronts a wide berth. They are ALL dangerous. NEVER camp on sea ice if it can be avoided.

41. Seals emerge to sun on the sea ice through breather holes more easily made and kept open in the thin ice near working cracks in sea ice, through tidal cracks along shore, near grounded bergs, and at junction of shelf and sea ice. Where seals are numerous and safe, man is not.

42. If you find yourself in the water KEEP in MOTION. You can swim 100 to 200 yards <u>fully</u> clothed if you have to - in fact, your clothing helps rather than

hinders buoyancy, so KEEP IT ON. If you get out on the ice and there is no help, KEEP ON YOUR FEET and KEEP IN MOTION some more. It is the only way you can keep warm until help arrives.

43. If you become lost, keep your head. In poor visibility, whiteout, fog, blizzard and darkness, STAY WHERE YOU ARE. You are safer, and someone will find you.

44. If a man becomes lost in a blizzard or fog:

a. At night, shine a strong light straight up.

b. In daytime, shout, whistle, make other loud noise.

c. Let the lost man find the party - don't further separate the party by sending other men to also get lost.

45. It has long been believed that undirected walk in the north is in a circle to the right - in the south, one is supposed to circle to the left from some fabled coriolis effect in the inner ear! Actually, solitary man probably circles in the direction of his shorter leg at either end of the earth. A compass, chart and previous study of terrain will help prevent circling. There is much more comfort in a survival manual read before an accident than afterwards.

46. Never be careless with equipment, tools, or clothing between use, for it can blow away or drift over in a matter of minutes. Stand up everything you can stick in the snow. If it won't stand up and you expect to find this object or location at a later date, it MUST be adequately flagged.

47. On the trail, split essential items such as food, fuel, stoves, shelter, sleeping bags, survival gear, and essential medical items between sled, trucks, and individual packs, so that loss of one vehicle or man will not endanger the entire group. In small parties with only one radio or one survival essential, carry those treasures on the last sled.

48. Beware of inhaling gasoline or carbon tetrachloride fumes in "pits" or in closed spaces. There have been a number of acute liver deaths in the Arctic from this cause. Beware of mouth siphoning gasoline or leaded fuels.

49. Use some caution with your "guts;" the latter alone pays off mostly on football fields, with hospitals nearby. Take nothing for granted. Familiarity breeds contempt. DON'T forget safety for a minute.

50. When forced down or in distress, remember to keep transmitting SOS signals on the "Gibson Girl" for 5 minutes on the hour and half-hour, when position reports are expected and frequencies are monitored. Signals are stronger at night, at sea, and at times between stratospheric electrical "storms" (blackout). Signals may bounce over home base a few miles away, but be heard at unexpected

distances. Don't give up for fear the radio is not working or that you are not being heard. KEEP GRINDING.

51. Simple light reflectors about camp and on trails used during the long polar nights increase safety of movement by man in lighted vehicles or carrying flashlights (torches).

52. Practice fire, man overboard, first aid and other drills until they are automatic and FAST. The life you save may be your own.

53. Have you checked up lately on your knowledge of Morse Code, first aid, navigation, or survival procedures?

54. Polar "adventures" are almost always the result of incompetency, ignorance or inexperience. Success and survival depend on planning, timing, and sensible use of supplies and equipment.

55. Keep comfortably cool, PHYSICALLY and MENTALLY, yet remain alert. Relax once and the artificial wall of security which you have painstakingly erected about yourself can give way without warning. There is never an uneventful journey in polar regions.

56. The life you risk is not only your own. It is also the lives of a lot of other people who will volunteer or be expected to go look for you if you come a cropper.

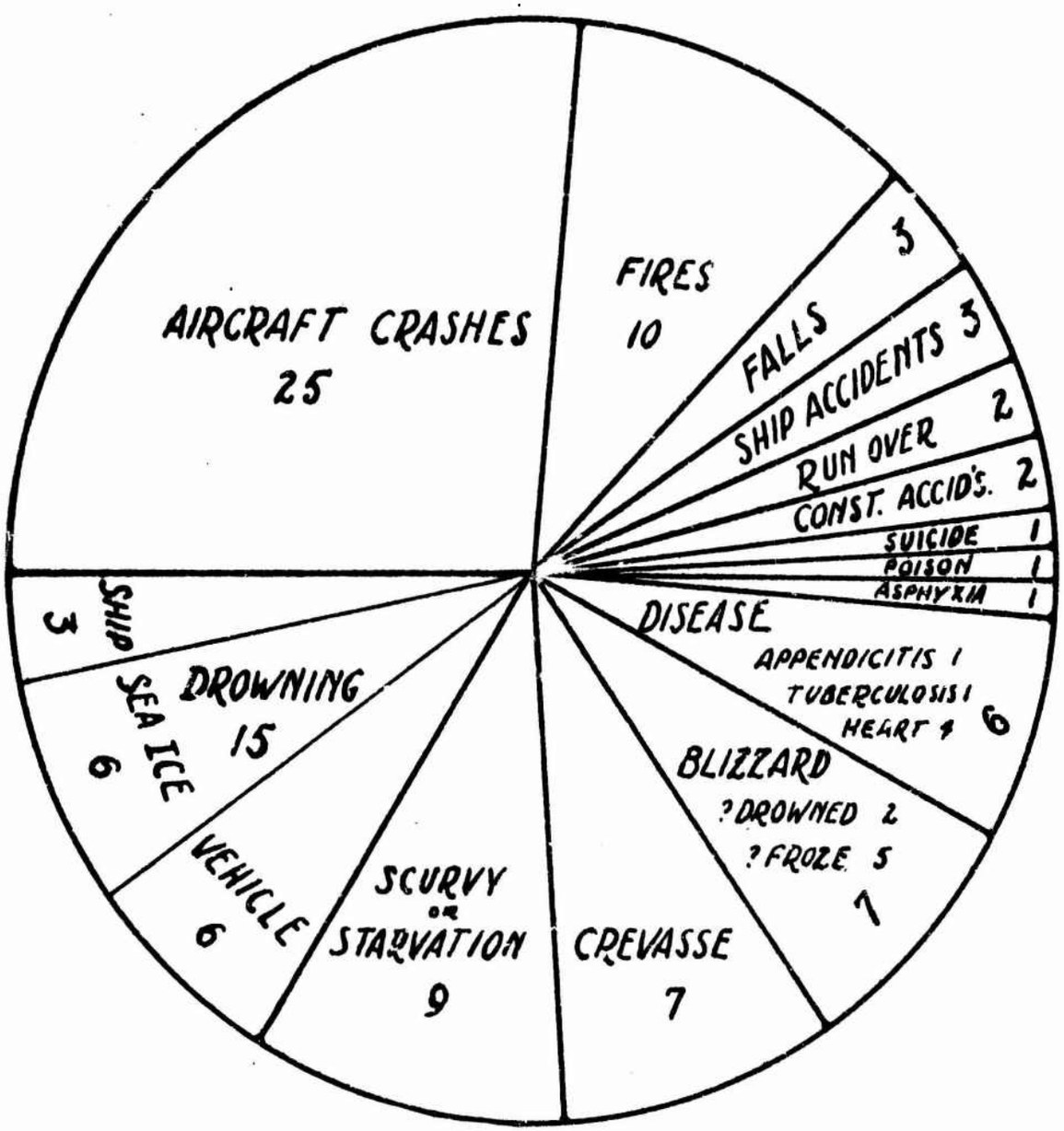
ARCTIC AND ANTARCTIC MORTALITY

During the "heroic" era of man-hauling and dog-sledging, from 1839 through 1917, disease claimed 4, starvation 9, drowning 4, and a ship accident, a suicide and a crevasse accident one each. Blizzards were directly or indirectly involved in 8 of these 20 deaths.

The "transition" period of exploration between 1918 and 1950 claimed three in a crash, two in a fire, two lost in blizzards froze to death, one drowned, and one was run over by a vehicle. The modern or mechanized era since 1950 has accounted for the other 64 dead.

More than one in four Antarctic deaths have been in plane crashes; three helicopters (5 dead); 3 ski plane (11 dead); one seaplane (3 dead); and one wheeled aircraft (6 dead). Two of these fatal crashes were due to whiteout (4 dead); two to broken weather (10 dead); two purely to pilot error (3 dead); one to fire of undetermined origin in the aircraft (5 dead); and one to motor failure (3 dead).

ANTARCTIC MORTALITY



Americans	29	French	4	German	1
Englishmen	23	Australian	4	Irish	1
Russians	12	Belgians	2	Japanese	1
Argentineans	6	Swedes	2	New Zealanders	1
Chileans	6	Czechs	1	Swiss	1

The figure above shows the causes for all 93 known deaths which have occurred south of the Antarctic Circle through 1964.

To impress the preceding lists of POLAR DO'S and DON'T'S, the following information is offered:

One Swede, one Englishman, and one Australian broke rules 3, 42 and 43 and drowned. One Swede, two Americans, and two Englishmen, among many more, followed rule 42 and lived to tell of it.

One Englishman, one Chilean and one Frenchman violated rules 4 and 5 and one Japanese obeying rule 5, but not rules 4 and 43 have never been found.

One Argentinean, two Chileans, and an Englishman violated rules 6 and 9 and were killed in crevasses. A number of men have luckily survived these violations, but not without injuries.

One Englishman violated rule 7 and drowned. The few survivors of this rule have usually lost at least one toe from freezing.

A New Zealand "V.I.P. tourist" was injured and quite frightened in a violation of rule 8 at an American camp.

Two Russians died unavoidably from violation of rule 10. One prominent American scientist fortunately survived such an accident, his buddy (Rule 5) was successful in getting help, a rubber boat, and a helicopter.

One Russian and two American accidents point up rule 11. In one case two men with plans quickly bailed out, saving three shipmates, losing one. Total three dead.

At least five Americans with skin grafts can attest to rule 12.

Violation of Rule 13 alone has caused six deaths and at least six serious injuries to Americans.

Six Americans were lucky to survive the breaking of Rules 14 and 15.

Four amputated American legs from two different plane crashes attest to the validity of Rule 20.

Two Englishmen and one Chilean broke Rule 23 and unfortunately died. An Australian broke Rules 24 and 25 and was run over and killed by his own tractor. One American violating Rule 25 was killed aboard ship.

Before the yellow flying glass was discovered, 10 out of 25 United States crashes were caused by flying in whiteout or marginal weather, with a total of eight dead and eight injured. Rule 28 can well be observed. To date there have

been eight cases of snowblindness on DEEP FREEZE, but none while wearing the prescribed glasses in the prescribed manner.

Starvation with vitamin deficiency has taken the lives of nine Antarctic explorers and nearly taken a number more.

Violation of Rule 33 has taken the lives of an Argentinean and an American. The often told but never written tales of alcohol on former expeditions makes one's hair stand on end.

Six Russians, two Englishmen, a Czech, and a German have died, and a number of others have nearly lost their lives trying to rescue them (Rule 38).

Five British and one Argentinean tried to violate Rule 40 and have never been seen again. Meals for a killer whale?

One Swiss died and an Australian made a "hands and knees" survival because they broke Rule 47.

How often the lesser rules have been complicating factors in the above deaths, no one knows; yet it must be surmised quite often. At least one party of Americans violated rule 50, and except for early transmissions which were heard, might never have been found. They were rescued just before they reached one of the most dangerous crevassed areas in Antarctica on a trek to the coast in search for food.

Over the first ten years of DEEP FREEZE, there were roughly two and one-half times as many accidents and injuries, yet only one-third the death rate per capita in Antarctica as in the rest of the Navy at large. The deaths were all violent or traumatic. The vast majority of these injuries and deaths were NOT due to over-enthusiasm or overwork (which make men accident-prone), but to carelessness, thoughtlessness, not learning these basic DO'S and DON'T's or to familiarity breeding contempt.

TAKING THE ANTARCTIC FOR GRANTED IS NO WAY TO COLLECT ONE'S RETIREMENT AND LONGEVITY PAY, NOR TO LIVE TO TELL ONE'S GRANDCHILDREN "SEA STORIES."

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